1988 HAMILTON - WENTWORTH
AIR QUALITY

SEPTEMBER 1990

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1. SUMMARY

Airborne particulates (dust) and odours have been Hamilton's main air pollution problems over recent years. In 1988, particulate levels, namely dustfall, reduced significantly across the City. Odours due to reduced sulphur compounds were also reduced dramatically in 1987. Further improvements are still necessary as dustfall still remained well above objectives in the industrial zone, and odours continued to occur, especially at the Beach Blvd. area.

The Air Pollution Index reached the advisory level of 32 once in 1988 compared to 2 occasions in 1987. The new Air Quality Index implemented in June, 1988 showed that ozone and suspended particles were the pollutants of greatest concern, reaching the moderate and poor ranges of the new index most frequently of six measured pollutants.

The network of fluoride monitors indicated lower concentrations than 1987, but levels near Hamilton Brick were well above objectives, sufficient to cause vegetation damage near the plant. The company has undertaken an abatement program to reduce their fluoride emissions.

Gaseous pollutants showed little change in 1988 except for ozone. Ozone is one of two gases which continued to exceed criteria. It is a product of long range transport and is produced photochemically to excess during the summer. Due to an extremely hot summer, ozone reached the moderate and poor ranges of the AQI from 108 to 196 hours at four Hamilton stations. In past years only 20 to 30 such hours were measured.

Total reduced sulphur concentrations reduced dramatically in the city during 1987. The improvement appears directly related to Stelco Inc. replacing direct contact coolers in the coke oven by-products area with indirect coolers in April

1987, and changes in slag quenching practices. The only place where improvement did not occur was the Beach Blvd. area. Stelco's effect there was limited by distance. Hamilton's other steel company - Dofasco Ltd., and to a lesser extent the Carbochem tar plant, continued to impinge on the Beach. In 1988, levels actually increased at the Beach for reasons unknown.

Total reduced sulphur compounds are a major cause of odours. Negotiations with industry for reductions of these emissions are ongoing. Control programs or studies are underway at Stelco, Carbochem and Dofasco. Naphthalene is also an odourous compound and Carbochem's control programs will eliminate these odours.

Airborne dust measurements near Steetley Industries, a limestone quarry in Flamborough, showed that further improvement in dustfall levels occurred in 1988 following the installation of a new electrostatic precipitator at the company's processing plant. However, suspended particulate measurements continued to show a localized problem, and some dustfall levels were still above objectives. Further measures are being taken by the company to improve air quality.

2. INTRODUCTION

The Air Management Program in Ontario is based on controlling man- made emissions to meet ambient air quality objectives, which in turn are based on known effects on health, quality of life, sensitive vegetation or materials, whichever is most stringent. To achieve these objectives, sources of pollution are identified, their emissions evaluated and appropriate control measures are instituted. Ambient air monitoring is used to identify pollution sources and to verify that controls have been successful. Monitors are usually sited in areas suspected of experiencing higher levels of air pollution. When these areas achieve acceptable air quality, then it is assumed that other areas should also be acceptable.

3. MONITORING NETWORK

The Ministry of the Environment operates a network of ambient air monitors throughout Hamilton as shown in Figure 1 and Table 1. The network centres on six automated stations which continuously monitor a variety of pollutants and telemeter hourly averaged data to a central computer facility in Toronto. These stations are:

29000 - Elgin/Kelly, downtown
29025 - Barton/Sanford, between downtown & the industrial zone
29102 - Beach Blvd
29105 - Nash/Kentley, in the east end
29114 - Vickers/East 18th, on the mountain
29118 - Main West/Highway 403, in the west end

As a new feature to this report, data from a station at the Joseph Brant Hospital in Burlington operated by the Ministry's Central Region will be presented in this report. This station is known as 44008 - Highway 2/North Shore Blvd.

The remainder of the network consists of numerous but less sophisticated monitors, many of which have been in existence since 1970. In addition to this regular network, special surveys are sometimes carried out to evaluate specific problems.

In June, 1988, the Ministry commenced broadcasting the new Air Quality Index across the Province. It is measured at over 30 locations, including the downtown, east, west and mountain stations in Hamilton and the Burlington station. A description of the AQI and the 1988 results will appear later in this report.

Meteorological data (wind speed, wind direction and air temperature) are observed at station 29026, (Woodward Avenue) located on the sewage treatment plant grounds. Figure 2 presents the wind frequency distribution measured and clearly indicates that winds from the southwest predominate.

The results of a computer program known as a "pollution rose" are included in this report. The program is essentially a cross-tabulation of hourly pollutant concentrations with wind direction. The data from this program are illustrated on various diagrams. On each "rose", the length of each line drawn is proportional to the average concentration of a pollutant when the wind was blowing <u>from</u> that direction. The longest lines in the diagram usually point to a source or sources of the pollutant in question. The concentrations will be influenced both by the quantity of emissions and by meteorological conditions such as wind speed, etc. As a result, the program is a useful tool in identifying sources of pollutants.

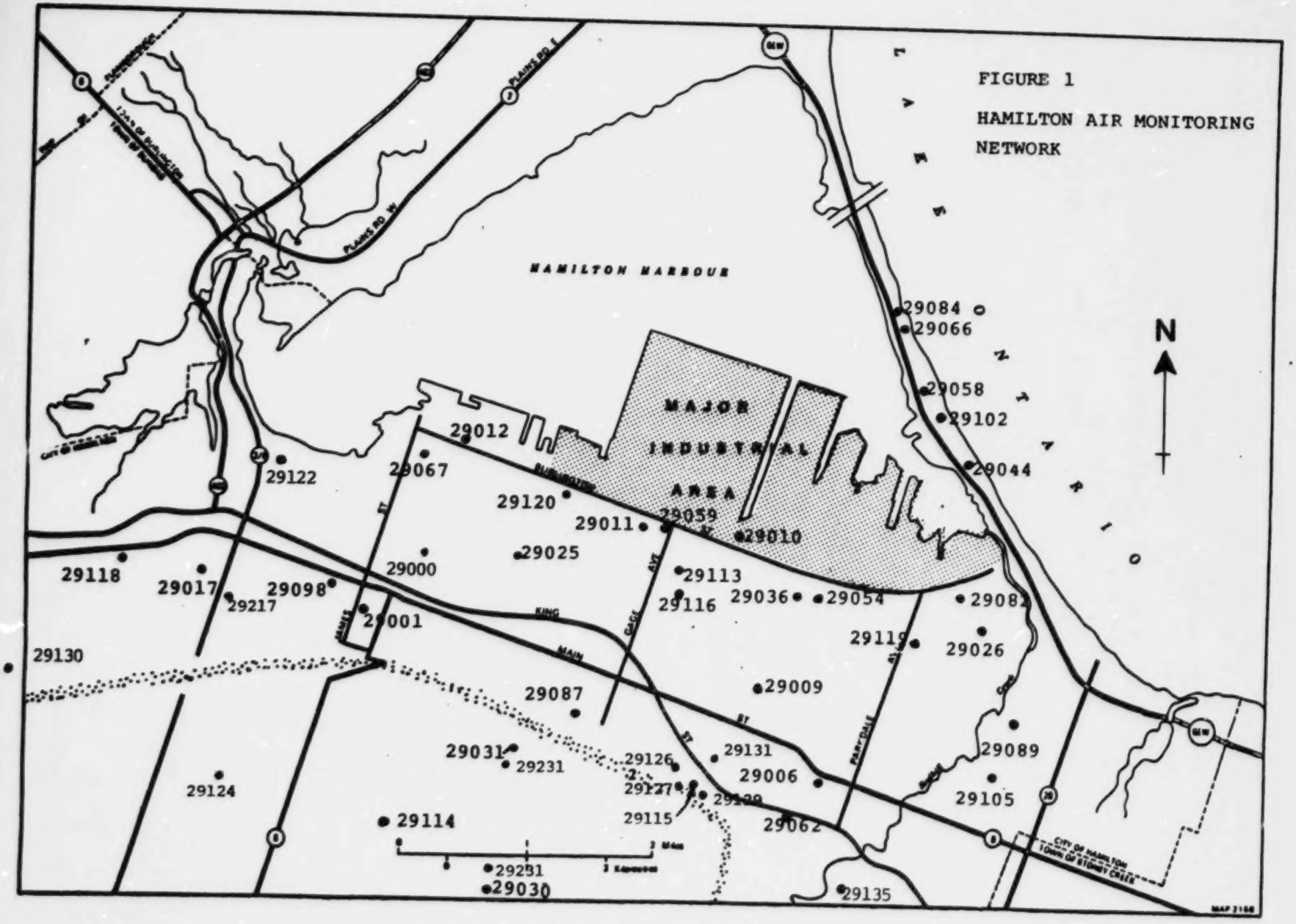


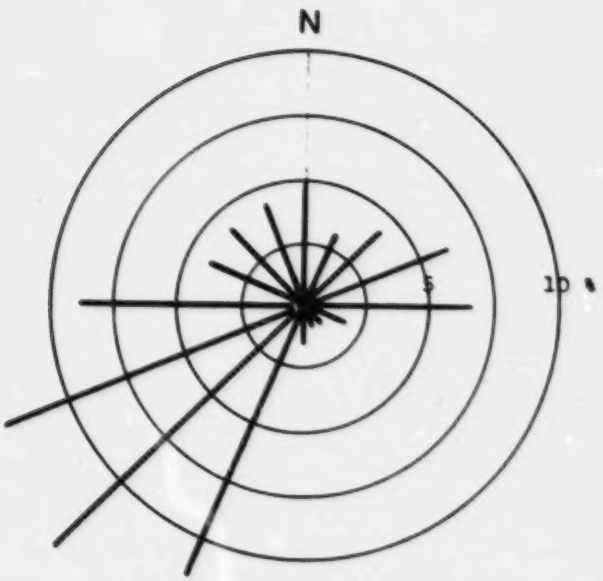
FIGURE 1
HAMILTON AIR MONITORING NETWORK
HAMILTON HARBOUR
LAKE ONTARIO
MAJOR INDUSTRIAL AREA
N
29084
29066
29058
29102
29044
29012
29122
29067
29120
29011
29059
29010
29025
29000
29113
29116
29036
29054
29082
29118
29017
29098
29217
29001
29130
29119
29026
29087
29009
29089
29031
29231
29126
29131
29006
29105
29124
29127
29115
29062
29114
29231
29030
29135
CITY OF HAMILTON
TOWN OF ANCASTER

FIGURE 2

WIND FREQUENCY DISTRIBUTION

HAMILTON - 1988

29026- Woodward Ave. Sewage Treatment Plant



Lines indicate direction from which wind blew

TABLE 1

HAMILTON AIR MONITORING STATION LOCATIONS

NUMBER	LOCATION	Air Quality Index	Sulphur Dioxide	Ozone	Carbon Monoxide	Oxides of Nitrogen	Total Reduced Sulphur	Soiling Index	Suspended Particulate	Fluoride	Dustfall	Wind/Temp.
29000	Elgin/Kelly	X	X	X	X	X	X	X	X			
29001	Hughson/Hunter							X		X	X	
29006	Queenston/Craigroyston										X	
29009	Kenilworth/Roxborough								X		X	
29010	Burlington/Ottawa										X	
29011	Burlington/Leeds								X		X	
29012	Burlington/Wellington								X	X	X	
29017	Chatham/Frid								X		X	
29025	Barton/Sanford		X				X	X	X	X	X	
29026	Woodward/Brampton											X
29030	Camden/Mohawk										X	
29031	Concession/Upper Sherman										X	
29036	Roosevelt/Beach Boulevard										X	
29044	Wark/Beach Boulevard										X	

TABLE 1 (cont.)

HAMILTON AIR MONITORING STATION LOCATIONS

NUMBER	LOCATION	Air Quality Index	Sulphur Dioxide	Ozone	Carbon Monoxide	Oxides of Nitrogen	Total Reduced Sulphur	Soiling Index	Suspended Particulate	Fluoride	Dustfall	Wind/Temp.
29054	Beach Road/Conrad									X		
29059	Burlington/Gage									X		
29062	King E./Barons									X		
29066	Killarney/Beach Blvd.									X		
29067	Hughson N./Macaulay								X			
29082	Leaside/Knox										X	
29084	Rembe/Beach Blvd.										X	
29087	Cumberland/Prospect								X			
29089	Barton/Nash								X			
29098	Bay/Main West								X			
29102	Beach Blvd./Towers		X		X	X	X	X	X		X	
29105	Nash/Kentley	X	X	X				X				

TABLE 1 (cont.)

HAMILTON AIR MONITORING STATION LOCATIONS

NUMBER	LOCATION	Air Quality Index	Sulphur Dioxide	Ozone	Carbon Monoxide	Oxides of Nitrogen	Total Reduced Sulphur	Soiling Index	Suspended Particulate	Fluoride	Dustfall	Wind/Temp
29113	Gertrude/Depew								X			
29114	Vickers/East 18th	X	X	X			X	X	X			
29115	London/Justine									X		
29116	Dalkeith/Ottawa									X		
29118	Main W./Highway 403	X	X	X		X		X	X			
29119	Morley/Parkdale								X	X		
29120	Dickson/Burlington									X		
29122	Dundurn/York								X			
29124	Laurier/Columbia								X			
29126	Rosslyn/Montclair									X		
29127	Lawrence/Balmoral									X		
29129	Province/Justine									X		
29130	Ewen/Whitney								X			
29131	Central/Graham									X		
29135	Mt. Albion/Albright								X			
44008	Hwy 2/N.Shore Blvd. Burlington	X	X	X	X	X		X	X			

4. ANALYSIS OF DATA

4.1 Air Quality Index

The AQI is a system by which the public can be informed about air quality on a daily and even hourly basis. The index supplemented the old Air Pollution Index which has been in place since 1970, and still exists as a subindex of the AQI.

In the AQI, hourly concentrations of sulphur dioxide, soiling index (particles), nitrogen dioxide, carbon monoxide, ozone and reduced sulphur compounds are all converted to a common scale of numbers. In addition to these hourly measurements, 8-hour average levels of carbon monoxide and the API, a 24-hour function of sulphur dioxide and particles are also included as subindices making a total of 8 potential subindices measured every hour. The official AQI broadcast is the highest subindex at that time.

The common scale of numbers are classified as follows:

0-15	Very Good
16-31	Good
32-49	Moderate
50-99	Poor
100+	Very Poor

Index levels up to 31 should have little or no effect on people and the environment. Beginning at the moderate level, effects such as odour, vegetation damage and some health effects to sensitive individuals start to occur.

In the poor and very poor categories, these symptoms become more and more acute such that virtually all people would be hampered in the very poor range.

When moderate levels or higher are measured, public health advisories can be issued to the public along with the actual index number.

The AQI started in June 1988, and statistics on hourly frequencies in the five concentration categories for the four Hamilton stations and the Burlington station are presented in Table 2.

Although the index only began in June, the AQI results are presented as if the index had been in actual operation for the entire year. As can be seen, ozone (O_3) was the most problematic pollutant followed by suspended particles (COH). More details on these pollutants and the others in the AQI will be discussed in the following sections of this report.

TABLE 2

AIR QUALITY INDEX - 1988

HOURLY FREQUENCY DISTRIBUTION

		0-15 Very Good	16-31 Good	32-49 Moderate	50-99 Poor	100 - Very Poor
29000	SO_2	8539	1	0	0	0
Elgin/Kelly	COH	7900	583	82	2	0
Downtown	O_3	8222	402	136	8	0
	NO_2	8566	4	0	0	0
	CO 1 hr	8564	0	0	0	0
	CO 8 hr	8583	0	0	0	0
	TRS	8396	133	18	0	0
	API	6990	1520	40	0	0
29105	SO_2	8479	0	0	0	0
Nash/	COH	8025	153	18	0	0
Kentley	O_3	7767	479	103	5	0
East	API[7]	4932	53	0	0	0
29114	SO_2	8465	0	0	0	0
Vickers/	COH	8156	195	9	0	0
E18th	O_3	7854	443	151	5	0
Mountain	TRS	7721	160	26	0	0
	API[7]	4931	122	0	0	0
29118	SO_2	6647	0	0	0	0
Main W.	COH	7231	460	36	0	0
West	O_3	7900	428	186	10	0
	NO_2	8266	2	0	0	0
	API[7]	4515	449	0	0	0
44008	SO_2	8671	1	0	0	0
Hwy2/N.Sh.	COH[7]	4612	356	33	0	0
	O_3	7885	279	34	3	0
Burlington	NO_2	8496	1	0	0	0
	CO 1 hr	8403	0	0	0	0
	CO 8 hr	8403	0	0	0	0
	API[7]	4171	848	0	0	0

7 - 7 months of data

4.2 Air Pollution Index

The Hamilton air pollution index (API) continued to be used as a warning system to alert the public to elevated air pollution levels and as a trigger for cutbacks in industrial emissions. It is derived from 24 hour average concentrations of sulphur dioxide and particulate matter. The combination of these two pollutants at elevated levels is indicative of detrimental human health effects. Hourly concentrations of both pollutants are telemetered to a central computer facility in Toronto which then calculates the index hourly, based on the following equations:

Downtown $API = 1.47(16.4\ COH + 122.9\ SO_2).^{93}$
East $API = 5.18(4.7\ COH + 124.4\ SO_2).^{64}$
West $API = 2.84(10.8\ COH + 120.9\ SO_2).^{77}$
Mountain $API = 2.68(11.0\ COH + 122.2\ SO_2).^{79}$
Burlington $API = 2.24(1.30\ COH + 123.6\ SO_2).^{83}$

Where: COH is the 24-hour average soiling index concentration expressed in coefficient of haze units.

SO_2 is the 24-hour average sulphur dioxide concentration expressed in parts per million.

No action is taken for readings up to 31. At 32 (Hamilton stations only), known as the advisory level, and with a forecast of unfavorable dispersion conditions, major industries in Hamilton are notified and asked to voluntarily curtail certain operations. At an API of 50, cutbacks by these sources become mandatory. These levels are set with a considerable safety margin before health effects to sensitive people would be expected. At 75, further cutbacks would be ordered, and at 100 all sources not essential to public health and safety could be ordered to cease operations.

During 1988, there was one incident in which the API reached or exceeded 32, occurring at the downtown station during November 25-27.

The 40-hour incident was a result of the classical lake breeze phenomenon, in which a warm southerly air mass was undercut by a cool northeast breeze off a cold Lake Ontario resulting in a temperature inversion.

There is high variability in the numbers of incidents each year. This variability is weather related, that is, the frequency of typical inversion conditions. However, there does appear to be a general decline in the frequency of these incidents.

4.3 Particulates

There are three basic types of instruments employed for the measurement of particles, each type relating to a different size range:

(a) Dustfall jars measuring heavy material, generally greater than 10 microns in diameter (one micron is one-millionth of a metre).
(b) High volume samplers measuring suspended particulates ranging in size from submicron to 50 microns.
(c) Co-efficient of haze tape samplers measuring mostly fine material - from submicron to about 10 microns.

The ambient air quality objectives for suspended particulate are based on health effects when occurring in combination with sulphur dioxide. As mentioned previously, this combination was proven to be indicative but not necessarily causative of such health effects. The dustfall objectives are based on nuisance effects while the soiling index objectives were derived from correlations with suspended particulate data.

4.3.1 Total Suspended Particulates

A high volume sampler draws a known volume of air through a pre-weighed filter for a 24 hour period (midnight to midnight). The exposed filter is weighed and the difference (weight of particulate matter on filter) in conjunction with the known air flow is expressed as a concentration in micrograms per cubic meter. The objective for a 24-hour average is 120 ug/m^3 while the yearly geometric mean objective is 60 ug/m^3.

At two locations in Hamilton, the Elgin/Kelly and Beach Blvd. stations, these samplers operated daily. At 17 other locations, they ran on a once every sixth day cycle,

consistent with the practice in other North American jurisdictions. The Burlington station ran once every three days.

Suspended particulate data is summarized in Table 3a and shows a definite gradient of higher concentrations closer to the industrial area. Concentrations in 1988 were fairly similar to 1987 levels.

The overall trend in TSP since 1970 is shown in Figure 3, which displays a leveling off in concentrations since 1977, although a slight downward trend over these years is still evident. The trend curve for industrial emissions also shows a slight downward slope over this period. While the trends of TSP and emissions are similar, the magnitude of change is not, the emissions have decreased more than the TSP. This is probably because other pollution sources, which have not been lessened, had and continue to have an effect on the TSP, e.g. unquantified sources such as road dust, wind blown dust from unpaved areas etc.

Pollution roses (Figures 4-6) for 1981-88 suspended particulates were manually calculated for all stations by grouping the data according to predominant daily wind directions (as opposed to the hourly pollution rose computer program which classes hourly data). Only those days for which a clear predominant direction could be determined were included and rainfall/snowfall days were excluded. Since most of the stations operate once every sixth day, roses for a single year cannot be drawn due to an insufficient number of samples per year. A multi-year approach was therefore made. Most of the 14 roses indicate a strong correlationship of higher averages with winds from the industrial sector. Several of the roses indicate local non-industrial influences as well, such as road traffic.

The hi-vol filters were analyzed for seven metals, as well as sulphates and nitrates (Table 3b).

Concentrations of nickel, cadmium, lead and vanadium showed very low concentrations which did not vary appreciably throughout the city indicating that they were background levels. The 24-hour criteria for these metals were easily met. Starting in 1987, nickel averages showed an increase, but this is due to changes in data handling procedures rather than real change. Most of the samples recorded levels below the analytical detection limit. A change in how the computer handles these values affected the newer averages.

Concentrations of chromium and manganese showed a gradient with distance from the industrial area. However, even the highest levels were well below acceptable levels. A change in chromium averages is due to the same reasons as mentioned above for nickel.

Iron concentrations were high, and also showed a gradient with distance from the industrial area where concentrations were often well above general background levels, but usually below guideline values which are based on soiling effects.

The sulphate/nitrate components comprised a large portion of the measured particulate matter. These constituents are largely by-products of major high temperature fuel combustion sources and can travel hundreds of miles from their source. The concentrations in Hamilton are normally higher in the industrial area, indicating a contribution from local industries. However, in 1988, mountain station 29114 recorded the highest yearly mean, much higher than that of industrial zone station 29011.

Most of the City shows levels only moderately higher than other areas in the province including rural areas, indicating that much of this material is imported into the city via long

range transport from distant sources. The sulphate/nitrate components are known to be a factor in reduced visibility[3] and are often responsible for the widespread haze observed in Hamilton during southerly winds.

With the exception of the mountain location, the sulphate/nitrate concentrations showed large decreases at most stations in 1988. The decrease in levels which are largely imported into the city, may indicate that a lesser amount of "background" particulate entered the city from distant sources. Sulphate/nitrate levels decreased throughout Southern Ontario in 1988.

It should be noted that the sulphate/nitrate analyses are subject to some error due to the measurement methodology. For this reason the data should be primarily used for evaluation of trends rather than use of the actual values. Alternative methodologies and filters are under investigation to improve the measurement technique. Tests with a new filter medium indicate that the glass fibre filter can cause as much as 8 ug/m^3 on average of spurious sulphate/nitrate formation from gaseous sulphur dioxide and nitrogen oxides. It is possible that the normally higher industrial area sulphate levels are related to this error, since gaseous sulphur dioxide and nitrogen oxide levels are somewhat higher there.

Hi-vol filters from four stations were analyzed for total carbon, elemental carbon and carbonate. Elemental carbon would include material such as coal, coke and kish, while total carbon would include numerous forms, both organic and inorganic in nature. Carbonate would include calcium carbonate (limestone) and dolomite. Sources of these carbonaceous materials would include coke ovens, blast furnaces, stockpiles, vehicle exhaust, biological materials and crushed stone.

Data are given in Table 3c and show a distinct gradient in concentration with distance from the industrial area. Levels were highest at 29011 (Burlington/Leeds) in the middle of the industries, followed by 29025 (Barton/Sanford) and 29102 (Beach Blvd.) on the fringes of the area followed by much lower levels at 29114 (Vickers/E18th) on the mountain. These higher particulate levels are a result of both direct emissions and contributions from traffic, particularly heavy truck traffic.

A contour map of suspended particulate concentrations is given in Figure 7. It can be seen that the majority of the city met the yearly objective of 60 ug/m^3. Concentrations were only elevated close to the industrial area. Once again it should be stressed that airborne particulate is not solely due to direct emissions from industrial sources. Dirty roadways and heavy truck traffic can also be contributors.

It should be realized that these contour maps of concentrations are not strictly a definitive representation of city wide air quality. Local influences affect some of the stations, and several more stations are required to fill in some gaps. One small contour drawn in Figure 7 does not have strict scientific validity. It is drawn to indicate that particular station was subject to local sources such as traffic and wind blown dust, unrepresentative of overall patterns.

Figure 7 reflects long term average conditions, and indicates a rather limited industrial contribution to suspended particulate levels throughout the city. A different situation exists during inversions accompanied by light northeast winds. Under inversion conditions, with poor dispersion, pollution from all sources, including traffic and industry, can accumulate and will contribute to the totals.

Figure 8 depicts suspended particulate contours during an elevated API incident on May 21. The map readily displays increased concentrations measured city-wide, diminishing with distance from the industrial complex. The contour is skewed toward the southwest reflecting the wind flow from the northeast. The industrial contribution is obvious on these occasions whether it be direct emissions, fugitive emissions or roadway sources inside or outside plants in the industrial area.

One other notable map for June 14, 1988 is given in Figure 9. This was a day of very strong southwest winds gusting up to 48 km/hr. TSP concentrations were high throughout Hamilton and were due to fugitive wind blown dust sources. As can be seen, contours ring the industrial zone, indicating the presence of fugitive dust sources there. Other stations also exhibited local effects. The Beach and Burlington/Leeds locations had the highest readings indicating that fugitive emissions need to be reduced in the industrial area.

In conclusion, the suspended particulate data indicate that the industrial area has an impact on the City, but that the effect is usually limited to a relatively small area near the mill sites. During inversion conditions, broader impacts are noted.

Most major sources in industry have now been controlled, and the remaining sources are being abated in compliance with Control Orders. These Orders include controls on Stelco's D blast furnace cast house. Dofasco has completed a control program at the No. 1 melt shop. Stelco will be required to upgrade controls on the sinter plant. Further upgrading of controls on the SWARU incinerator is proceeding. A Control Order has been served on Slater Steel to control particulate emissions and Canron Pipe will be upgrading their cupola pollution control equipment. Inside company properties, programs are in operation to control roadway sources of

particulate. Roads have been paved and road cleaning is performed regularly. Better control of trackout to public streets still appears necessary, as well as improved cleaning of public streets. Landscaping of industrial properties has also been ongoing for some time in order to reduce wind blown dust.

TABLE 3a

SUSPENDED PARTICULATES - 1988
UNIT - MICROGRAMS PER CUBIC METER
unless otherwise specified

ONTARIO OBJECTIVES: 24 hour - 120
1-year Geo. Mean - 60

LOCATION	Geometric Mean 1986	1987	1988	Maximum 1988	%of Samples Above 120 1988
29000 - Elgin/Kelly	-	-	68	223	13
29009 - Kenilworth/Roxborough	61	60	49	132	2
29011 - Burlington/Leeds	110	99	98	236	32
29012 - Burlington/Wellington	66	59	56	150	9
29017 - Chatham/Frid	79	80	80	220	23
29025 - Barton/Sanford	75	76	81	192	16
29067 - 450 Hughson St. N.	51	46	48	124	2
29087 - Cumberland/Prospect	52	51	52	135	2
29089 - Barton/Nash	62	54	63	173	8
29098 - Bay/Main	52	51	44	138	3
29102 - Beach Blvd.	73	70	77	286	20

TABLE 3a - Continued

SUSPENDED PARTICULATES - 1988
UNIT - MICROGRAMS PER CUBIC METER
unless otherwise specified

ONTARIO OBJECTIVES: 24 hour - 120
1-year Geo. Mean - 60

LOCATION	Geometric Mean 1986	1987	1988	Maximum 1988	%of Samples Above 120 1988
29113 - Gertrude/Depew	87^{9}	84	81	189	23
29114 - Vickers/East 18th	45	53	48	102	0
29118 - Main W./Highway 403	47	52	43	154	2
29119 - Morley/Parkdale	96^{11}	104	90	225	21
29122 - Dundurn Castle	-	43	42	108	0
29124 - Laurier/Columbia	-	53^{7}	33*	64	0
29130 - Ewen/Whitney	-	40	39	222	6
29135 - Mt. Albion/Albright	-	43	34	87	0
44008 - Hwy 2/Northshore, Burlington	45	50	42	122	1

9 - Numerical exponent refers to number of months sampled when less than 12.
* - Station moved to 29124 from 29128 in mid-1988

TABLE 3b CONSTITUENTS IN SUSPENDED PARTICULATE (ug/m^3)

Station and Year	Criterion:2.0(24 hours) CADMIUM # of Samples	Geo. Mean	Max.	Criterion:1.5(24 hours) CHROMIUM # of Samples	Geo. Mean	Max.	Criterion:25.0(24 hours, Ferric Oxide) IRON # of Samples	Geo. Mean	Max.	Criterion:5.0(24 hours) LEAD # of Samples	Geo. Mean	Max.	Criterion:2.5(24 hours) MANGANESE # of Samples	Geo. Mean	Max.
29001/29098 Hughson/Hunter + Bay/Main															
1985	57	.001	.004	57	.001	.073	57	1.5	11.1	57	0.2	0.5	57	.09	.57
1986	59	.001	.017	59	.001	.084	59	1.7	38.0	59	0.2	1.1	59	.10	2.39
1987	55	.001	.012	55	.009	.040	55	1.5	13.1	55	0.1	0.4	55	.09	.68
1988	51	.000	.008	51	.006	.020	51	1.2	9.7	51	0.0	0.3	51	.06	.55
29008, 29102 Beach Blvd.															
1985*	52	.001	.004	52	.002	.037	52	2.5	12.2	52	0.1	0.5	52	.8	.81
1986	57	.001	.006	57	.002	.033	57	3.0	10.0	57	0.2	0.6	57	.17	.87
1987	51	.001	.007	51	.012	.060	51	3.0	20.3	51	0.1	0.6	51	.19	1.40
1988	63	.001	.006	63	.012	.060	63	4.0	14.9	63	0.1	0.3	63	.27	.89
29011 Burlington/Leeds															
1985	58	.002	.005	58	.020	.092	58	5.4	23.2	58	0.3	0.7	58	.40	2.16
1986	59	.001	.004	60	.018	.067	60	4.9	24.9	60	0.2	0.7	60	.41	1.32
1987	57	.001	.007	57	.026	.120	57	5.1	32.5	57	0.2	0.4	57	.32	1.84
1988	52	.002	.017	52	.019	.130	52	5.4	21.4	52	0.2	0.8	52	.35	.91
29012 Burlington/ Wellington															
1985	58	.001	.022	58	.002	.052	58	2.1	6.0	58	0.2	0.5	58	.16	1.29
1986	59	.000	.003	59	.001	.023	59	1.2	10.8	59	0.1	0.5	59	.12	.91
1987	57	.001	.009	57	.010	.030	57	1.4	10.5	57	0.1	0.3	57	.11	.81
1988	56	.001	.023	56	.006	.020	56	1.5	8.0	56	0.1	0.3	56	.10	.55

*29008 moved to 29102 in 1985. + 29001 terminated at end of 1987.

TABLE 3b CONSTITUENTS IN SUSPENDED PARTICULATE (ug/m^3)

Station and Year	Criterion:2.0(24 hours) CADMIUM # of Samples	Geo. Mean	Max.	Criterion:1.5(24 hours) CHROMIUM # of Samples	Geo. Mean	Max.	Criterion:25.0(24 hours)-Ferric Oxide IRON # of Samples	Geo. Mean	Max.	Criterion:5.0(24 hours) LEAD # of Samples	Geo. Mean	Max.	Criterion:2.5(24 hours) MANGANESE # of Samples	Geo. Mean	Max.
29017 Chatham/Frid															
1985	57	.001	.003	57	.001	.036	57	1.7	6.2	57	0.2	0.4	57	.09	.49
1986	57	.000	.002	57	.004	.035	57	2.4	12.8	57	0.2	0.7	57	.11	.47
1987	58	.000	.006	58	.009	.110	58	2.3	30.6	58	0.1	0.3	58	.12	.63
1988	54	.000	.004	54	.008	.030	54	2.2	7.4	54	0.0	0.5	54	.12	.43
29025 Barton/Sanford															
1985	51	.001	.006	51	.004	.309	51	1.5	14.9	51	0.3	1.1	51	.19	1.74
1986	55	.001	.004	55	.002	.086	55	2.8	26.8	55	0.3	1.0	55	.15	1.19
1987	53	.001	.013	53	.013	.200	53	2.5	29.6	53	0.2	1.2	53	.17	5.29
1988	43	.001	.004	43	.013	.110	43	2.7	17.6	43	0.1	0.4	43	.17	.96
29067 Hughson/Macauley															
1985	58	.001	.009	58	.001	.026	58	1.4	5.4	58	0.1	0.4	58	.09	.43
1986	58	.000	.003	58	.003	.028	58	1.0	11.6	58	0.1	0.5	58	.07	.50
1987	50	.001	.007	50	.012	.030	50	0.9	7.8	50	0.1	0.2	50	.06	.66
1988	54	.001	.005	54	.006	.020	54	1.2	7.2	54	0.1	0.2	54	.06	.43
29085/29114 Vickers/East 18															
1985	57	.001	.003	57	.001	.084	57	0.8	9.7	57	0.1	0.5	57	.06	.39
1986*	54	.001	.005	54	.001	.026	54	0.7	8.7	54	0.1	0.6	54	.05	.44
1987	55	.001	.007	55	.012	.060	55	1.1	22.1	55	0.1	0.5	55	.07	.90
1988	46	.000	.004	46	.006	.040	46	0.8	5.6	46	0.0	0.2	46	.04	.25

*29085 moved to 29114 at end of 1985

TABLE 3b CONSTITUENTS IN SUSPENDED PARTICULATE (ug/m^3)

	Criterion: 2.0(24 Hours)			Criterion: 2.0 (24 Hours)								
	NICKEL			VANADIUM			NITRATE			SULPHATE		
Station and Year	# of Samples	Geo. Mean	Max.	# of Samples	Geo. Mean	Max.	# of Samples	Geo. Mean	Max.	# of Samples	Geo. Mean	Max.
29001/29098 Hughson/Hunter + Bay/Main												
1985	57	.002	.015	57	.00	.04	57	3.1	10.0	57	6.9	16.2
1986	59	.001	.028	59	.00	.04	59	4.4	37.2	59	10.6	29.7
1987	55	.004	.020	55	.01	.06	56	4.2	16.1	56	10.5	20.8
1988	51	.006	.020	51	.01	.03	50	1.8	11.2	50	7.4	31.1
29008/29102 Beach Blvd.												
1985*	52	.003	.022	52	.00	.03	37	2.8	16.6	37	8.4	19.4
1986	57	.000	.025	57	.00	.04	57	3.5	18.8	57	10.9	39.7
1987	51	.006	.040	51	.01	.04	51	3.0	19.7	51	12.9	21.9
1988	63	.007	.020	51	.01	.05	50	3.2	34.2	50	10.7	33.7
29011 Burlington/Leeds												
1985	58	.004	.026	58	.00	.05	58	4.1	19.3	58	10.7	26.0
1986	60	.001	.024	60	.01	.04	60	4.1	36.4	60	12.3	43.4
1987	57	.006	.030	57	.01	.10	57	2.7	13.7	57	11.7	23.8
1988	52	.007	.030	52	.01	.04	51	2.3	11.2	51	8.4	38.2
29012 Burlington/ Wellington												
1985	58	.002	.059	58	.00	.03	57	4.3	14.9	57	9.2	21.7
1986	59	.000	.017	59	.00	.06	59	4.0	34.9	59	9.4	40.0
1987	57	.004	.020	57	.01	.07	57	3.1	12.0	57	8.7	19.3
1988	56	.006	.020	56	.01	.03	56	1.9	12.9	56	6.7	27.5

*29008 moved to 29102 in 1985. + 29001 terminated at end of 1987.

TABLE 3b CONSTITUENTS IN SUSPENDED PARTICULATE (ug/m^3)

Station and Year	Criterion: 2.0(24 Hours) NICKEL # of Samples	Geo. Mean	Max.	Criterion: 2.0 (24 Hours) VANADIUM # of Samples	Geo. Mean	Max.	NITRATE # of Samples	Geo. Mean	Max.	SULPHATE # of Samples	Geo. Mean	Max.
29017 Chatham/Frid												
1985	57	.004	.021	57	.00	.03	58	3.2	11.2	58	6.6	17.6
1986	57	.001	.022	57	.00	.14	57	3.5	11.5	57	9.2	44.0
1987	58	.005	.070	58	.01	.07	51	3.5	12.9	58	9.8	21.2
1988	54	.007	.030	54	.01	.03	54	2.0	9.3	54	6.5	29.9
29025 Barton/Sanford												
1985	51	.006	.040	51	.00	.04	52	3.3	14.7	52	8.4	18.9
1986	55	.001	.042	55	.00	.05	55	3.8	33.5	55	11.2	25.1
1987	53	.006	.060	53	.01	.14	54	3.9	17.6	54	13.0	40.9
1988	43	.007	.030	43	.02	.04	43	3.7	10.3	43	10.9	35.7
29067 Hughson/Macauley												
1985	58	.004	.039	58	.00	.03						
1986	58	.002	.020	58	.00	.02						
1987	50	.004	.010	50	.01	.03						
1988	54	.006	.030	54	.01	.04						
29085/29114 Vickers/East 18th												
1985	57	.001	.018	57	.00	.03	57	2.6	8.7	57	6.0	19.3
1986*	54	.003	.047	54	.00	.02	54	2.6	15.2	54	7.9	37.4
1987	55	.006	.120	55	.01	.09	56	4.6	12.5	56	11.6	24.4
1988	46	.006	.050	46	.01	.03	46	4.0	12.3	46	11.4	31.3

*29085 moved to 29114 at end of 1985

(cont'd.)

TABLE 3b CONSTITUENTS IN SUSPENDED PARTICULATE (ug/m^3) (continued)

Station and Year	Criterion: 2.0(24 Hours) NICKEL # of Samples	Geo. Mean	Max.	Criterion: 2.0 (24 Hours) VANADIUM # of Samples	Geo. Mean	Max.	NITRATE # of Samples	Geo. Mean	Max.	SULPHATE # of Samples	Geo. Mean	Max.
29087 Cumberland/ Prospect												
1985							56	3.0	11.3	56	7.3	20.4
1986							58	3.3	42.4	58	9.2	38.9
1987							57	3.2	14.5	57	10.1	18.6
1988							55	1.4	10.8	55	6.9	27.6
44008 Burlington- Hwy 2/Northshore												
1986							117	3.8	25.8	117	8.9	39.3
1987							101	4.0	15.1	117	10.5	51.2
1988							116	2.5	11.1	116	7.3	41.3

TABLE 3c

CARBON CONTENTS IN SUSPENDED PARTICULATES (ug/m³) - 1985-88

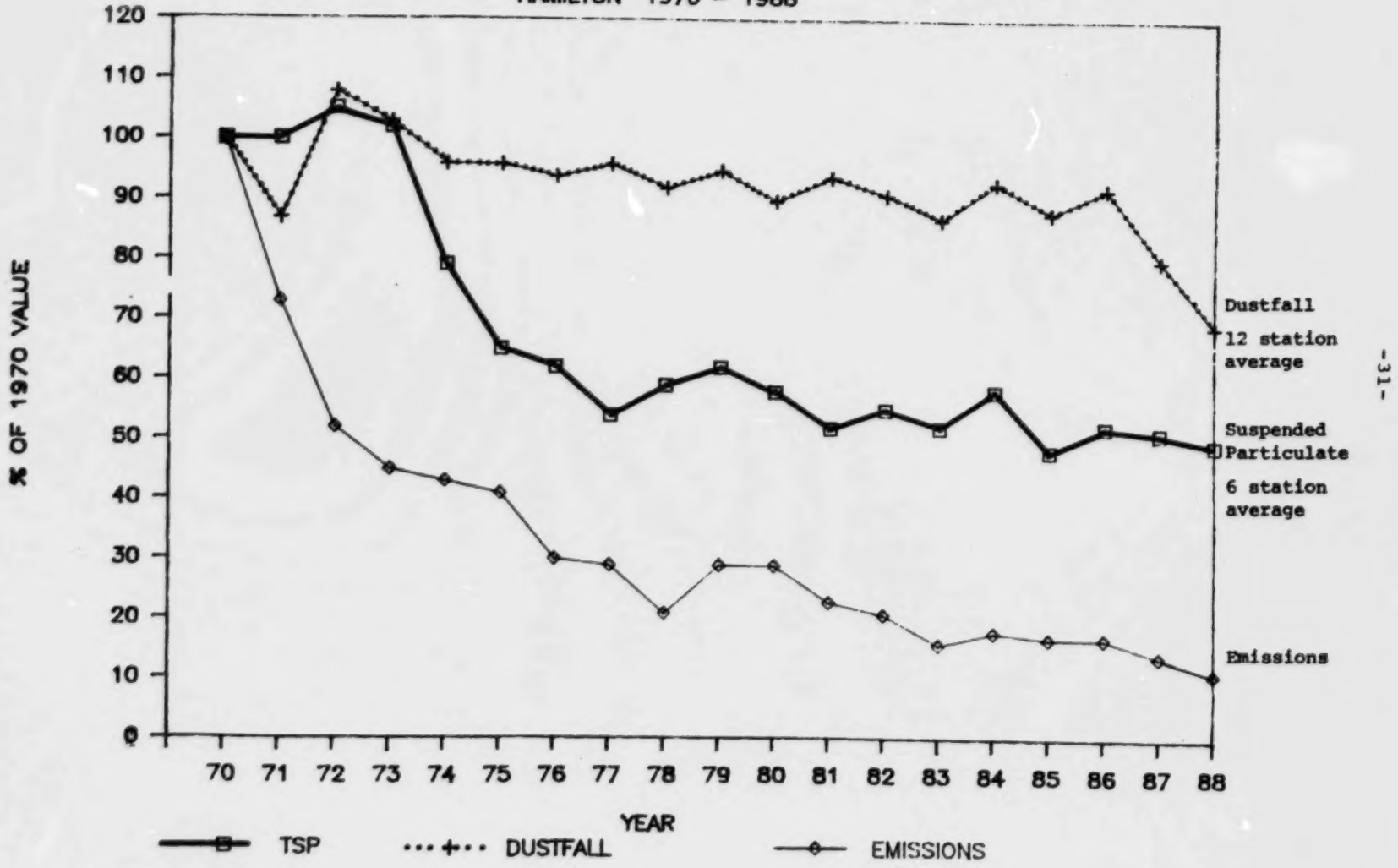
Station	Year	No. of Samples	TOTAL CARBON Geo.Mean	TOTAL CARBON Max.	ELEMENTAL CARBON Geo.Mean	ELEMENTAL CARBON Max.	CARBONATE (CO_3) Geo.Mean	CARBONATE (CO_3) Max.
29011								
Burlington/Leeds	1985	58	13.7	35.2	5.0	18.1	1.3	11.3
	1986	54	11.7	45.6	3.9	18.0	1.2	10.5
	1987	57	10.8	40.0	3.6	17.0	0.7	7.5
	1988	52	11.4	33.4	3.5	16.7	1.0	4.1
29025								
Barton/Sanford	1985	51	9.1	20.1	3.4	11.9	0.6	3.7
	1986	50	10.2	29.9	3.5	16.3	0.7	3.5
	1987	53	9.4	34.0	2.9	17.9	0.2	3.9
	1988	43	9.5	28.4	2.9	16.0	0.5	5.9
29085/29114								
Vickers/East 18th	1985	55	5.9	18.9	1.8	8.9	0.4	2.5
	1986*	52	5.4	23.4	1.0	6.8	0.1	2.7
	1987	56	5.8	20.3	1.2	7.3	0.1	4.4
	1988	46	4.8	11.1	1.1	4.4	0.0	1.2
29102								
Beach Blvd.	1985	52	9.4	27.5	3.4	14.0	0.4	2.2
	1986	49	8.5	20.6	3.5	13.5	0.3	9.4
	1987	51	7.1	24.1	2.6	11.2	0.1	3.3
	1988	50	9.0	29.1	3.4	11.7	0.2	1.5

* 29085 moved to 29114 at end of 1985

FIGURE 3

PARTICULATES/EMISSIONS TRENDS

HAMILTON 1970 – 1988



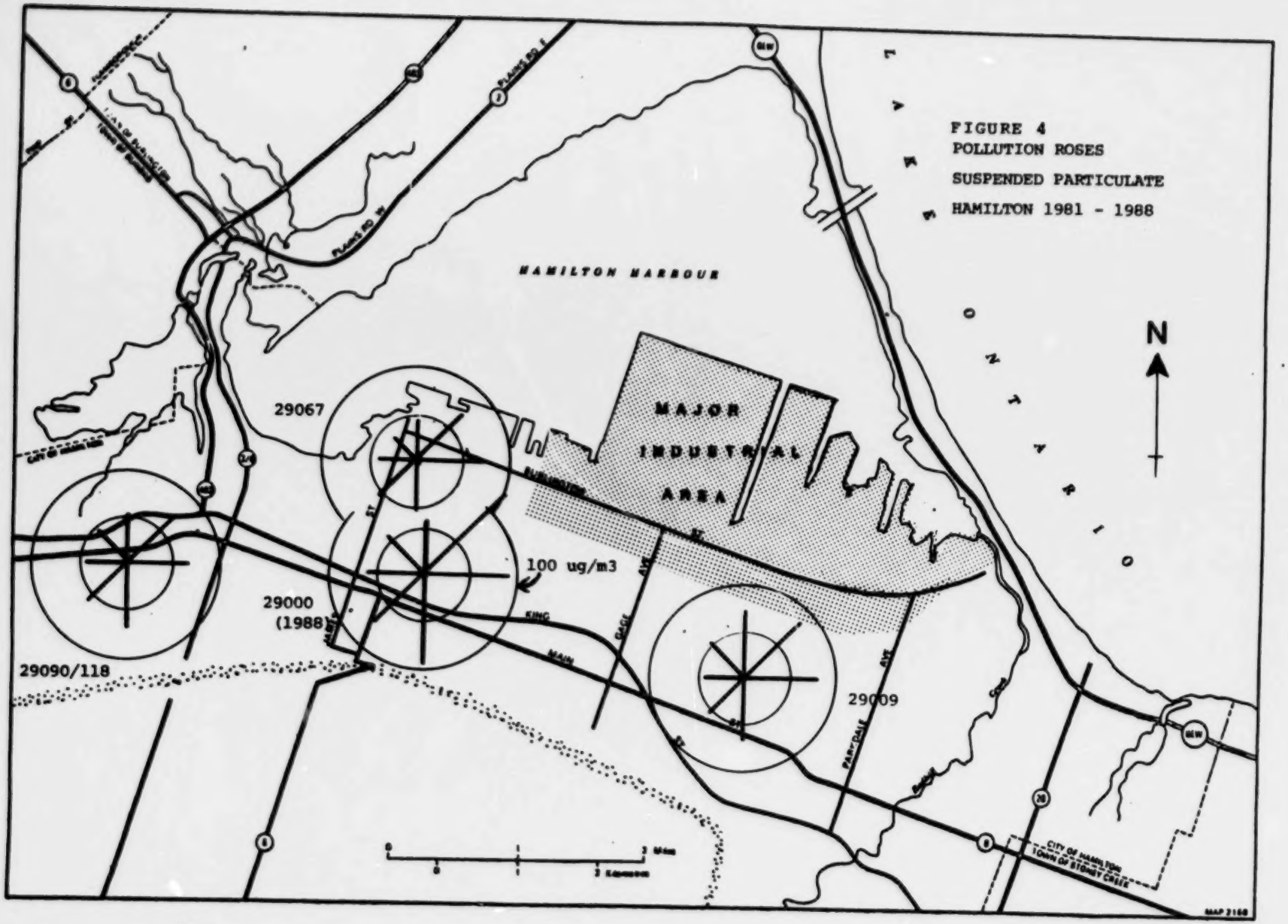


FIGURE 4
POLLUTION ROSES
SUSPENDED PARTICULATE
HAMILTON 1981 - 1988

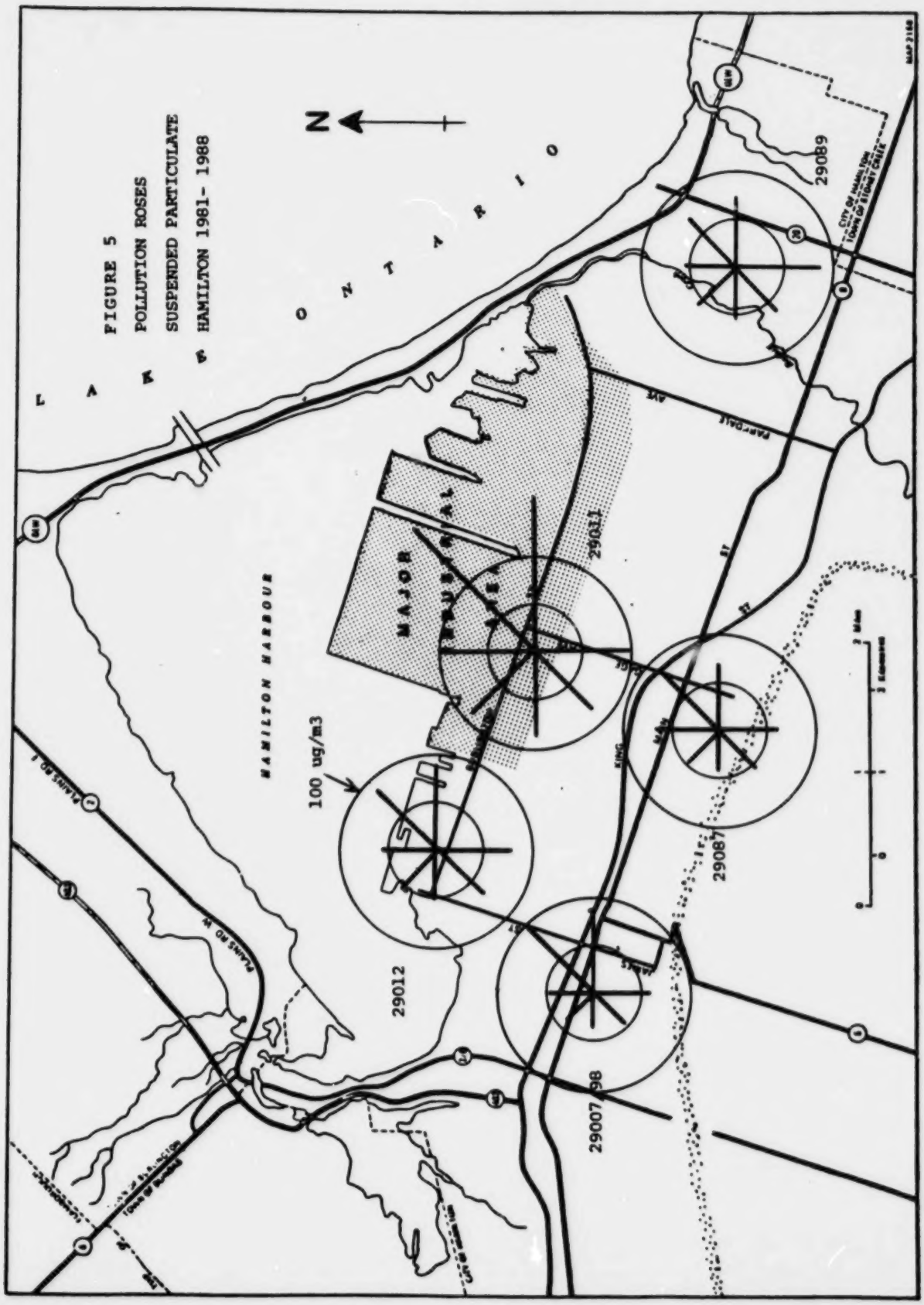


FIGURE 5
POLLUTION ROSES
SUSPENDED PARTICULATE
HAMILTON 1981- 1988
L A K E O N T A R I O
N
HAMILTON HARBOUR
MAJOR INDUSTRIAL
100 ug/m3
29012
29011
29087
29089
29007
98

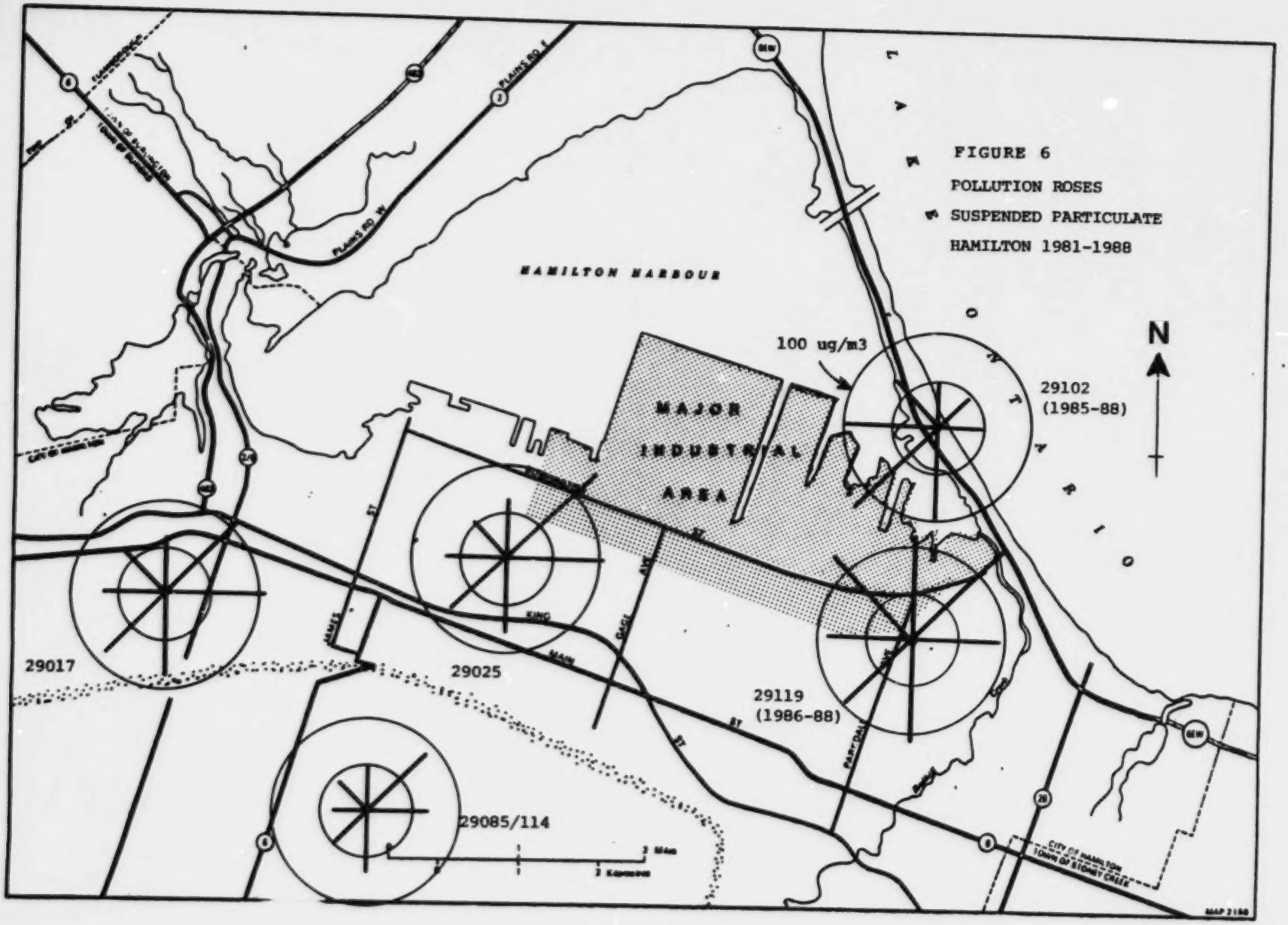


FIGURE 6

POLLUTION ROSES

SUSPENDED PARTICULATE

HAMILTON 1981-1988

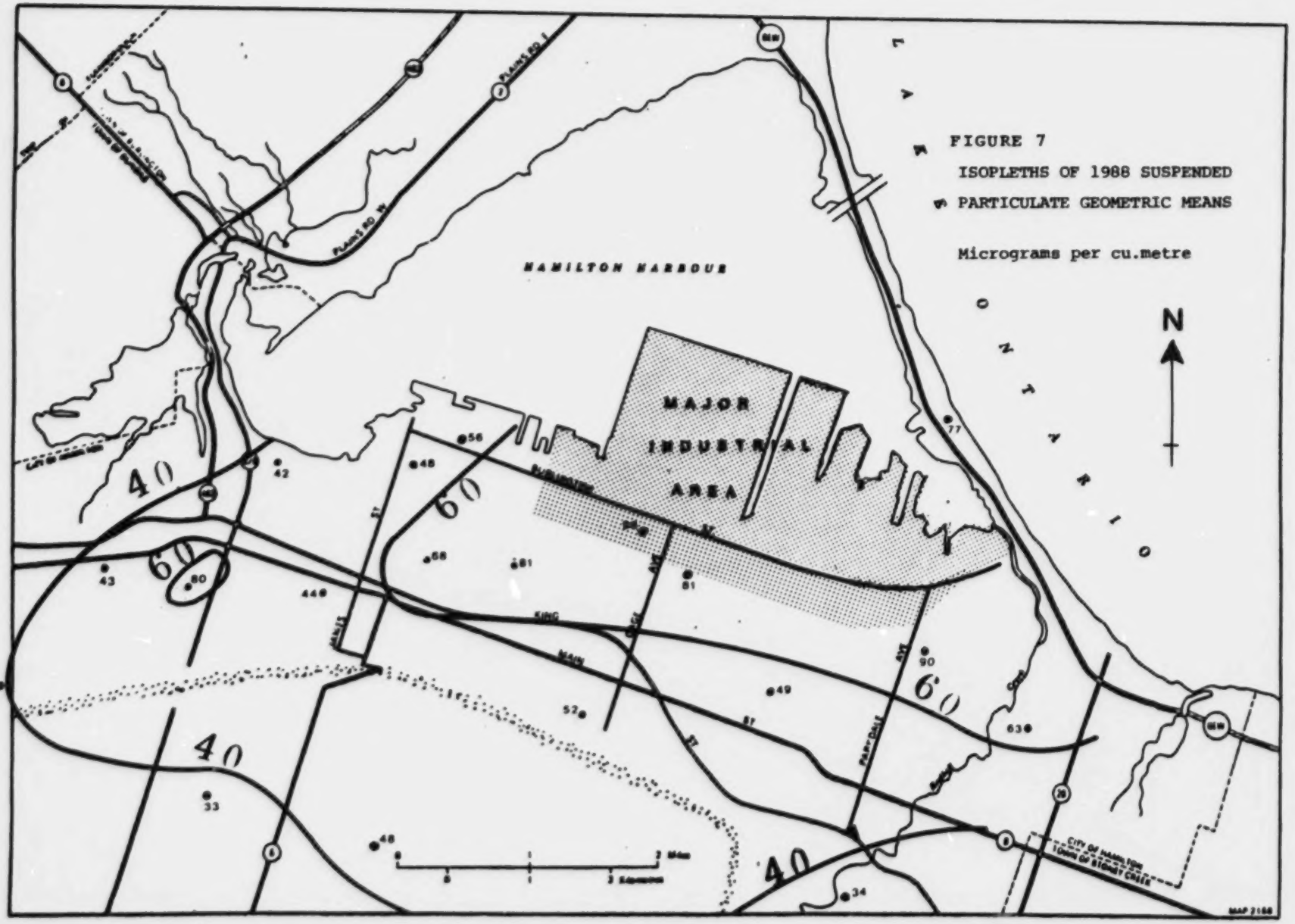


FIGURE 7

ISOPLETHS OF 1988 SUSPENDED PARTICULATE GEOMETRIC MEANS

Micrograms per cu.metre

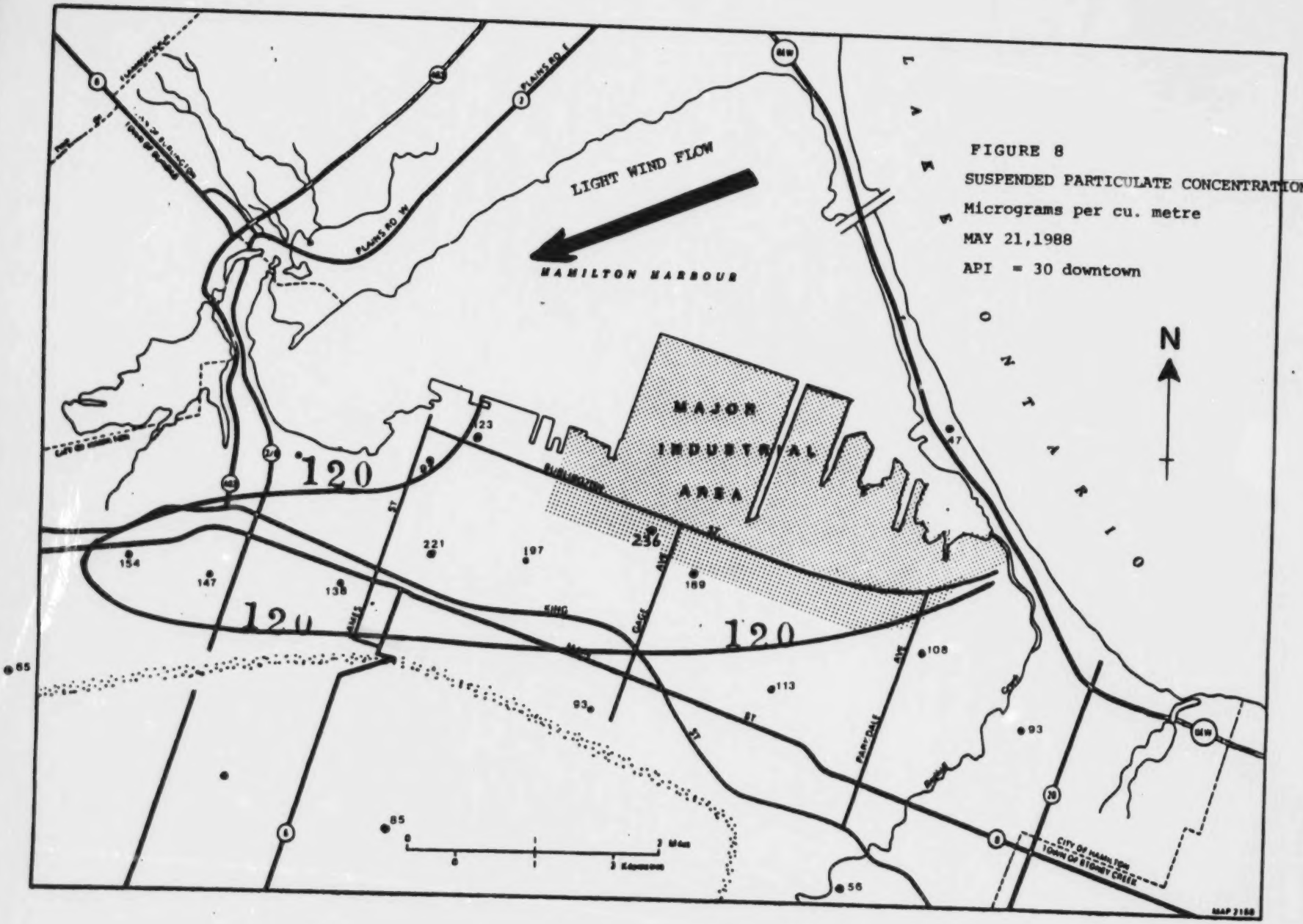


FIGURE 8
SUSPENDED PARTICULATE CONCENTRATIONS
Micrograms per cu. metre
MAY 21,1988
API = 30 downtown

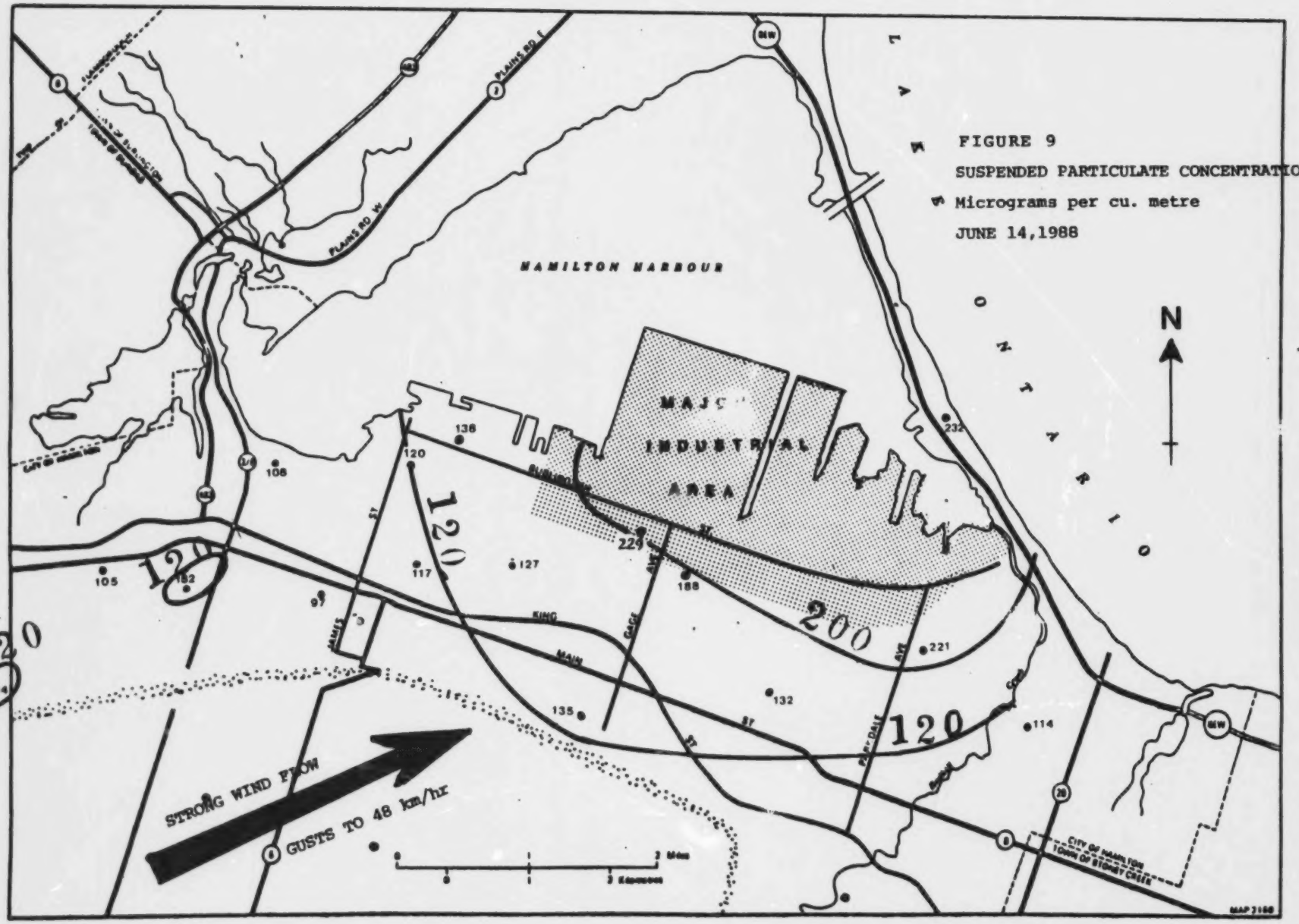


FIGURE 9

SUSPENDED PARTICULATE CONCENTRATIONS

Micrograms per cu. metre

JUNE 14,1988

4.3.2 Soiling Index (Co-efficient of Haze)

Co-efficient of haze tape samplers operate continuously and determine hourly soiling values. Air is drawn through a filter paper, and the optical density of the soiled spot is measured by light transmittance. The instrument takes readings prior to and after sample collection. The resultant light obstruction is determined and transmitted on a real time basis to the data bank for the eight telemetered stations. Data are given in Table 4.

In 1988, concentrations were below the yearly objective at 6 of 8 stations. Only 29025 (Barton/Sanford) and 29001 (Hughson/Hunter) were slightly above the objective.

The daily objective was most frequently exceeded at Hughson/ Hunter - a total of 24 days, followed closely by Elgin/Kelly and Barton/Sanford.

Historical data are available only for the Beach and Barton stations and trend graphs for both are illustrated in Figure 10. Barton has fluctuated near the annual objective since 1972 while Beach dropped dramatically in 1985 to the present time. This drop coincided with the move of the Beach station from its old North Park location immediately adjacent to the Queen Elizabeth Way. This old location was obviously heavily affected by highway traffic. In 1984, the daily COH objective was exceeded 79 times at North Park, compared to only one time at the new Beach Blvd. location in 1986 and none at all in 1987 or 1988. This tends to indicate that the soiling index measurement predominantly measures vehicle traffic particulate when located close to a traffic artery. This would account for the fact that Barton/Sanford COH levels have decreased only a small amount since the early 1970's compared to the large decreases in industrial particulate emissions noted in Figure 3.

Soiling index pollution roses are given in Figure 11. While the downtown (29000, 29001) and Barton Street (29025) stations show the highest concentrations, and do show averages under northeast winds up to about 0.9 COHs, these concentrations were inflated by inversion-time measurements which were partly traffic related. The east 29105 (Nash/ Kentley), west 29118 (Main West) and mountain (29114 - Vickers/East 18th) stations generally did not show peaks pointing at the industries. The east station is remote from traffic, while the west station is adjacent to the Highway 403 cutoff. The southeast peaks at the station near the 403 point to this roadway. The mountain station, also remote from traffic showed low averages from most directions and a slight lower-city influence was noted for northeast winds. The Beach station, although closest to the industrial area, showed the lowest levels. It did continue to show southwest peaks (from industry). However, they were half of what they were at the old North Park station. The QEW and Beach Blvd. are still upwind during southwest winds but farther away. Peaks at rush hours were still evident in the data at Beach.

The AQI stations each recorded COH levels in the moderate or poor ranges (Table 2). Downtown (Elgin/Kelly) measured 82 moderate and 2 poor hours; east (Nash/Kentley) measured 18 moderate hours; west (Main West) measured 36 moderate hours; mountain (Vickers) measured 9 moderate hours and the Burlington station measured 33 moderate hours. Most of these readings occurred during morning rush hours, although the west station tended to measure high levels in late evening hours. Traffic was probably a major contributor in these readings.

It is important to note that while traffic appears to affect the soiling index measurement more than industry, industrial emissions may still be contributing. Other fine particulate monitors measuring particles less than 10 microns have been used on an experimental basis. They correlate fairly well to

suspended particulate results, while soiling index correlates poorly. This is probably explained by the fact that the other fine particle samplers and suspended particulate methodologies involve weight determinations, while the soiling index uses the light scattering properties of particles. The soiling index measurement however, must be retained because it is the only practical method for measuring hourly concentrations.

TABLE 4

SOILING INDEX

1-HOUR TELEMETERED INSTRUMENTS

UNITS - COH's per 1000 linear ft. of air

Ontario Objectives - 24-hour - 1.0
1-year - 0.5

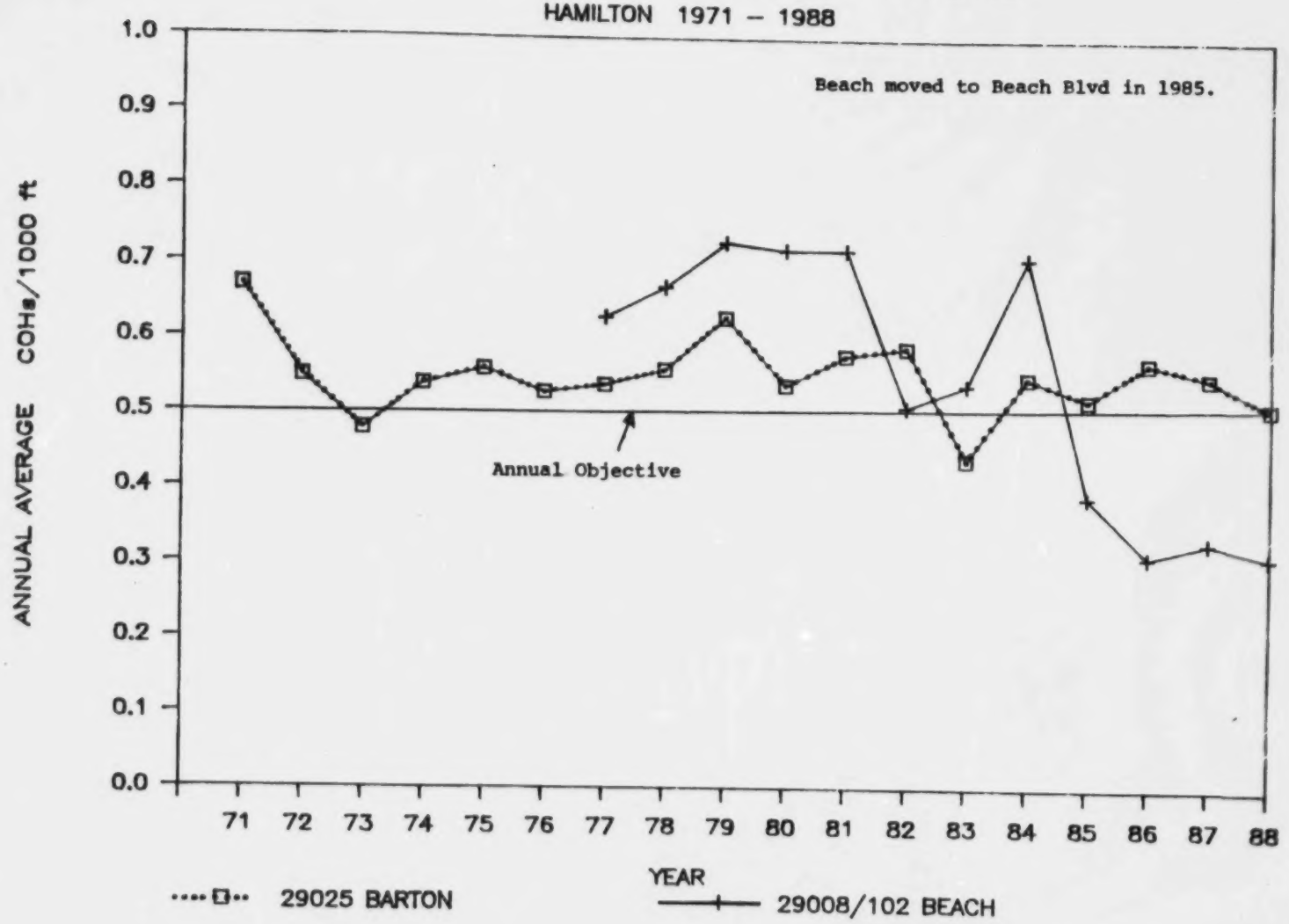
		Annual Average	Maximum 24-hour	No. of Times Above Objective 24-hour
29000 - Elgin/Kelly	1988	.46	2.2	20
	1987	.45*	1.8	7
29001 - Hughson/Hunter	1988	.54	2.3	24
	1987	.49	1.9	11
	1986	.50	1.7	10
29102 Beach Blvd.	1988	.23	1.0	0
	1987	.33	1.0	0
	1986	.31	1.3	1
29025 - Barton/Sanford	1988	.51	1.6	19
	1987	.55	1.8	15
	1986	.57	1.6	27
29105 - Nash/Kentley	1988	.31	1.4	2
	1987	.40	1.3	2
	1986	.38	1.1	1
29114 - Vickers/East 18th	1988	.29	1.2	4
	1987	.36	1.4	4
	1986	.33	1.2	3
29118 - Main W./Hwy. 403 1987	1988	.37	1.4	9
	1987	.42	1.6	9
	1986	.41	1.6	9
44008 - Hwy 2/North Shore, Burlington	1988	$.44^{7}$	1.4	7

9 - Numerical exponent refers to number of months sampled when less than 12.

FIGURE 10

SOILING INDEX YEARLY TREND

HAMILTON 1971 – 1988



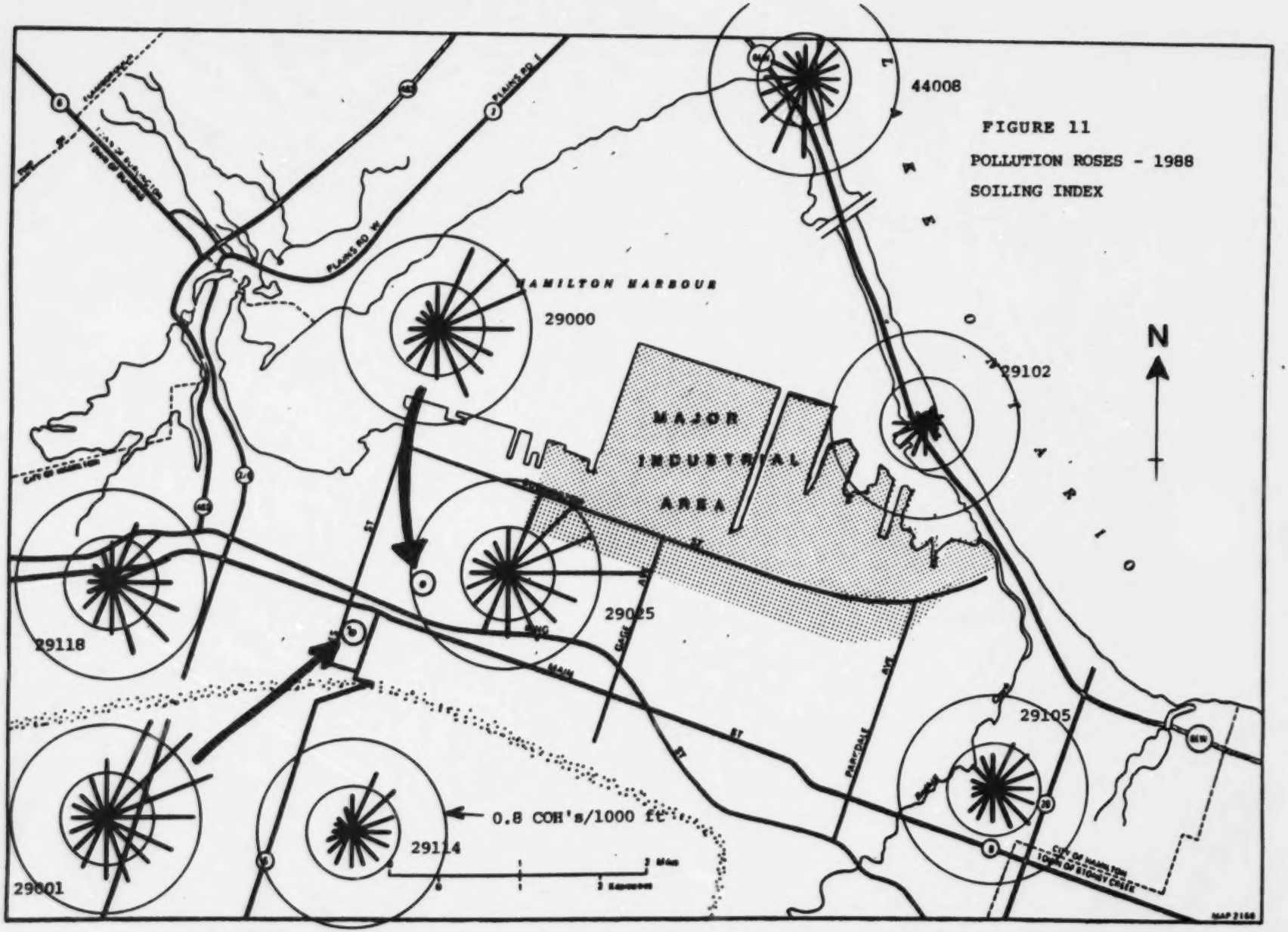


FIGURE 11

POLLUTION ROSES - 1988

SOILING INDEX

4.3.3Dustfall

Dustfall is that material which settles out of the atmosphere by gravity. It is collected in plastic containers during a 30 day exposure time. The collected material is weighed and expressed as a deposition rate of grams/square meter/30 days. The significance of observations is restricted to relatively local areas and dustfall objectives are based on visible deposit of dust rather than health effects.

Dustfall levels in 1988 (Table 5) decreased from previous years. Figure 12 depicts dustfall isopleths, and shows that a small portion of the lower city near the industrial area was encompassed by the 9.0 grams/m^2/30 days contour which represents twice the objective. Conditions in this area were quite poor. As with the suspended particulate contour maps, the dustfall contour map in Figure 12 is not strictly a definitive representation of conditions city wide. Local influences affect some of the stations and the measurement is rather imprecise. As well, a small contour drawn in Figure 12 has no scientific validity. It is drawn to indicate that particular station was subject to local influences, unrepresentative of general patterns.

Three additional samplers were located near existing stations to determine the representativeness of the old stations - in case there are undue local traffic effects. In all three cases, the new stations located on quiet side streets measured lower levels, below the yearly objective in two cases, and barely over in the other. The 29217 - Chatham/ Fanning location confirmed that the high readings at 29017 - Chatham/Frid were very localized. The 29230 - Cameo location also confirmed an impact of traffic on 29030 - Camden/Mohawk. The 29231 - Audrey station revealed lower levels than 29031 - Concession/Upper Sherman.

Significantly lower levels were recorded progressively in 1987 and 1988 throughout the City, such that on average, dustfall has decreased by 25% from 1986 levels which in turn had remained relatively unchanged since the 1970's. In 1988, 7 of the 18 stations were below the annual objective. Figure 3 displays the recent dustfall improvements following many years when levels remained virtually unchanged throughout the 1970's and 1980's. The absence of change in dustfall over the earlier years was surprising given the reductions in industrial process emissions and the correspondingly large reductions in suspended particulate concentrations noted in the same graph. Fugitive dust sources such as road dust, stock piles, unpaved areas, vehicle emissions, etc. are probably important in explaining this observation. The recent reductions represent the first significant improvement in dustfall levels.

As mentioned, road traffic is a major source of the dust at several of the stations. At Ottawa Street (29010), construction activities at Dofasco have resulted in extremely high concentrations being observed, of which a large portion can probably be ascribed to increased heavy truck traffic and quantity of dirt tracked onto the street near the station. The station at Chatham/Frid (29017) is also significantly affected by local fugitive sources such as road traffic and unpaved lots.

The recent improvements cannot be ascribed to any single initiative. City staff have modified road cleaning practices. Industry has continued control efforts such as the use of chemical sealants, road paving and road washing and planting of vegetation to control fugitive dust emissions. Past measurements on company properties indicated that fugitive dust emissions were considerable. There have also been improvements in control of industrial point sources. All of the above control efforts must be maintained

and expanded to achieve further improvements. These may include measures to reduce dirt trackout onto streets and increased planting of vegetation. Continued efforts by both industry and the municipality will be necessary.

TABLE 5

DUSTFALL 1988

Ontario Objectives - 1 month avg - 7.0
1 year ave - 4.5

UNITS - GRAMS/SQ. METRE/30 DAYS

	Annual Average			Maximum	Number of Months Above Objective
	1986	1987	1988	1988	1988
29001 Hughson/Hunter	6.2	5.3	4.4	6.9	0
29006 Queenston	6.4	5.7	4.4	8.9	1
29009 Kenilworth	4.6	4.0	3.7	6.5	0
29010 Burlington/Ottawa	19.9	19.7	16.2	29.3	12
29011 Burlington/Leeds	14.1	12.4	9.7	14.5	10
29012 Burlington/Wellington	8.8	6.8	6.1	9.1	3
29017 Chatham/Frid	9.7	9.9	8.1	10.6	10
29217 Chatham/Fanning	-	3.1[7]	4.6	13.5	1
29025 Barton/Sanford	5.9	5.0	4.6	9.1	1
29030 Camden/Mohawk	5.1	5.2	3.8	8.2	1
29230 Cameo Ave	-	3.9[6]	3.4	7.4	1
29031 Concession/Upper Sherman	7.1	5.5	5.0	8.5	1
29231 Audrey/East 27th	-	4.8[6]	3.5	6.5	0
29036 Roosevelt/Beach Rd.	18.8	15.3	14.1	16.7	12
29044 Wark/Beach Blvd.	9.3	6.7	7.4	13.0	5
29082 Leaside Rd.	8.1	7.5	6.5	12.2	4
29084 Rembe/Beach Blvd.	10.2	8.9	6.8	11.4	5
29102 Beach Blvd.	5.6	4.2	3.5	7.6	1

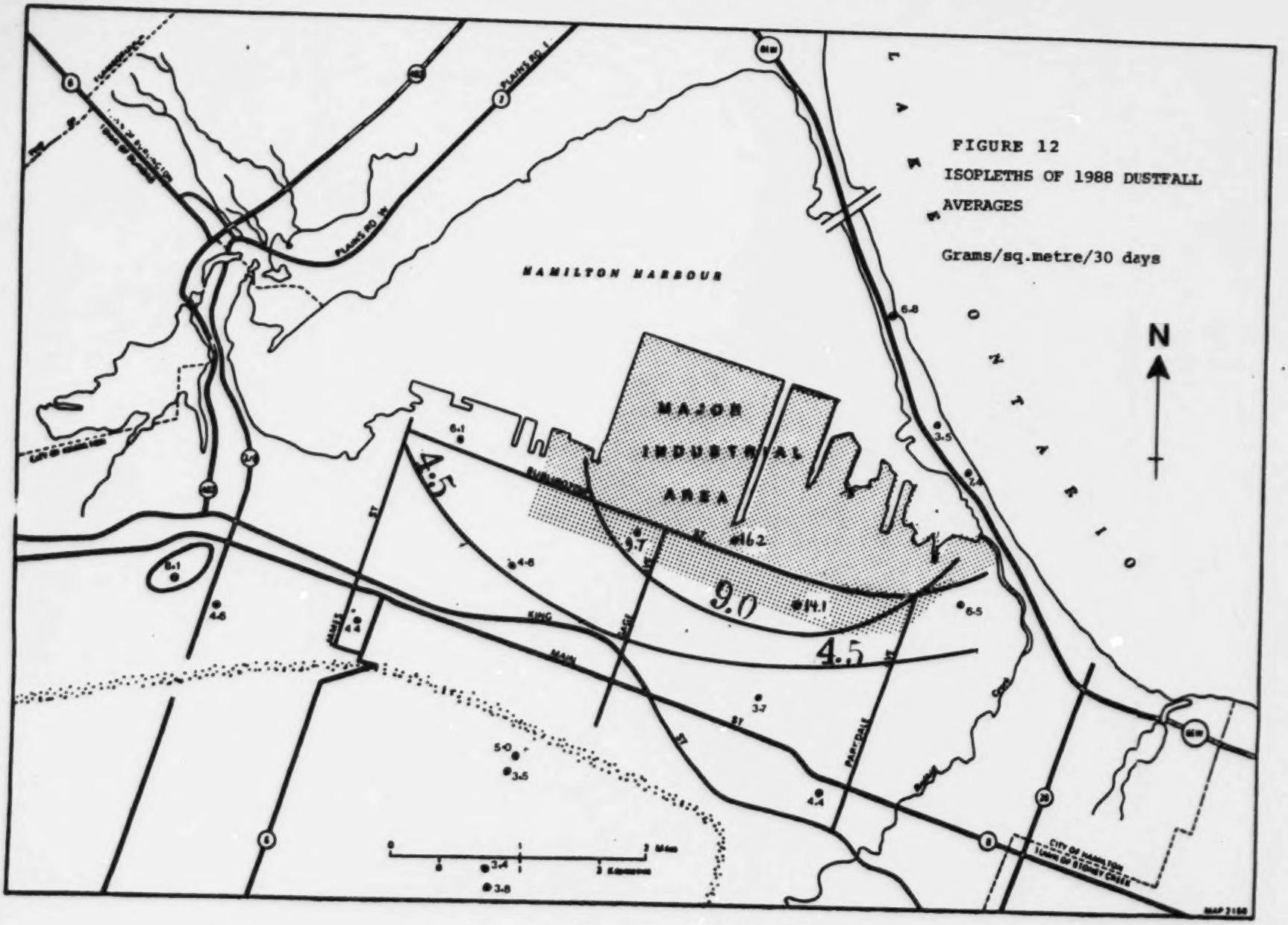


FIGURE 12
ISOPLETHS OF 1988 DUSTFALL
AVERAGES

Grams/sq.metre/30 days

4.4 Sulphur Dioxide

Most sulphur dioxide (SO_2) emissions in Hamilton stem from industrial sources. A smaller portion is accounted for by fuel burning in domestic space heating. Data for six stations are summarized in Table 6, which lists objective values that are based on vegetation damage (hourly and yearly) and health effects in conjunction with suspended particulate (daily).

Sulphur dioxide trends from the Barton and Beach stations since 1970 are illustrated in Figure 13. In 1988, as in the past several years, the concentrations were acceptable based on the yearly, daily and hourly objectives. Virtually all readings at all five AQI stations fell in the very good range of the AQI.

The pollution roses for the stations given in Figure 14 confirm that the industrial area is the prime source of SO_2 in the city. The east, west and Burlington stations show only small industrial influence. The mountain station recorded levels fairly similar to the downtown stations except that the northeast peaks were smaller.

TABLE 6

SULPHUR DIOXIDE

UNITS - PARTS PER MILLION

Ontario Objectives: 1-hour - .25
24-hour - .10
1-year - .02

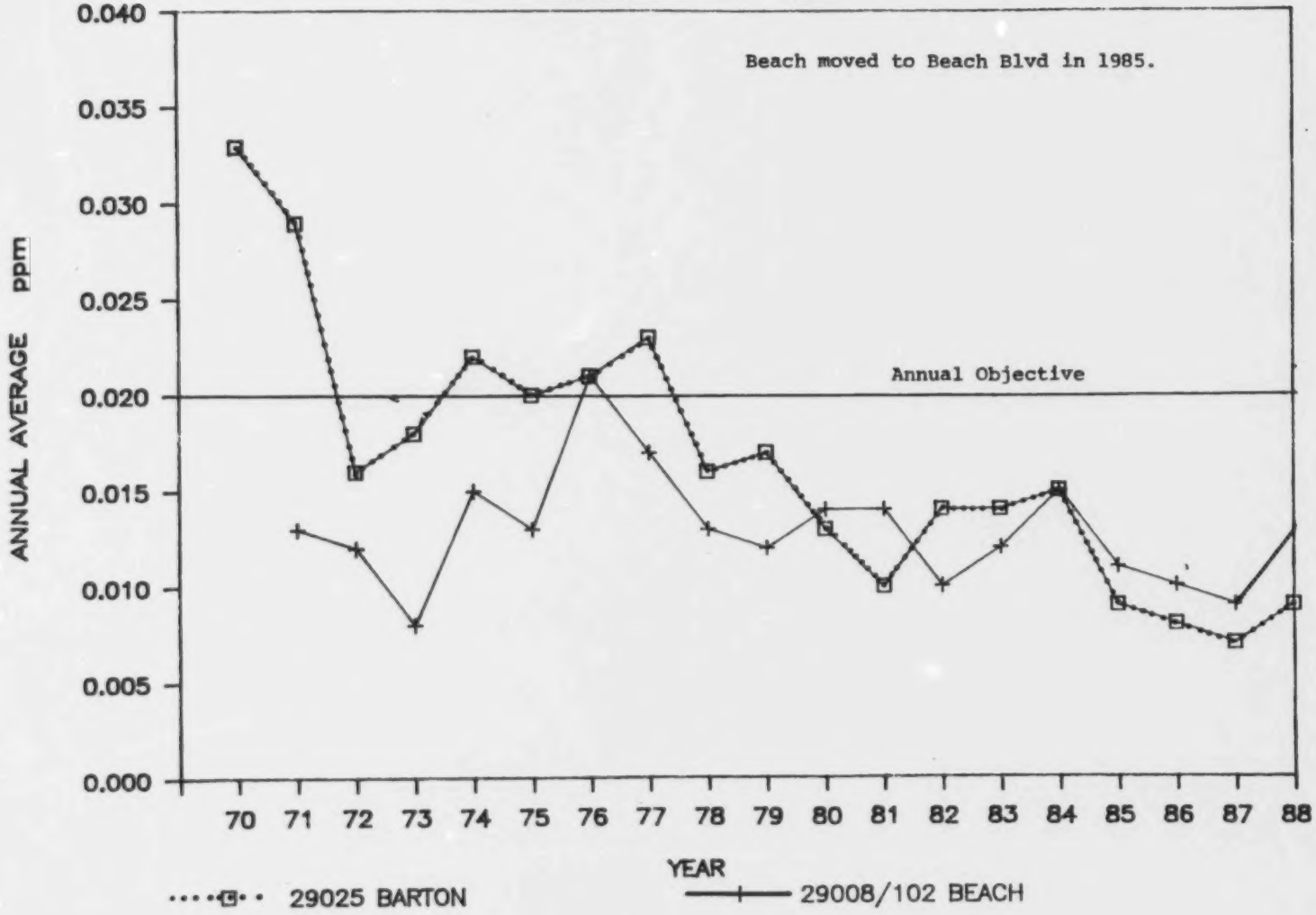
		Annual Average	Maximum 1-hour	Maximum 24-hour	No. of Times Above Objective 1-hour	No. of Times Above Objective 24-hour
29000 - Elgin/Kelly	1988	.008	.18	.05	0	0
	1987	.009	.24	.06	0	0
29102 - Beach Blvd.	1988	.013	.17	.07	0	0
	1987	.009	.17	.05	0	0
	1986	.010	.12	.07	0	0
	1985	.011	.12	.06	0	0
29025 - Barton/ Sanford	1988	.009	.15	.04	0	0
	1987	.007	.15	.04	0	0
	1986	.008	.14	.05	0	0
	1985	.009	.11	.06	0	0
29105 - Nash/ Kentley	1988	.005	.11	.03	0	0
	1987	.005	.14	.03	0	0
	1986	.006	.11	.03	0	0
	1985	.004	.16	.02	0	0
29114 - Vickers/ East 18th	1988	.007	.13	.04	0	0
	1987	.008	.36	.06	1	0
	1986	.009	.11	.05	0	0
29118 - Main W./ Hwy. 403	1988	.005	.11	.03	0	0
	1987	.006	.19	.03	0	0
	1986	.007	.24	.04	0	0
	1985	.005[6]	.06	.03	0	0
44008 - Hwy 2/N.Sh. Burlington	1988	.004	.20	.03	0	0
	1987	.004	.21	.05	0	0
	1986	.004	.08	.03	0	0
	1985	.004	.11	.03	0	0

6 - Six months of sampling (July - December).

FIGURE 13

SULPHUR DIOXIDE YEARLY TREND

HAMILTON 1971 – 1988



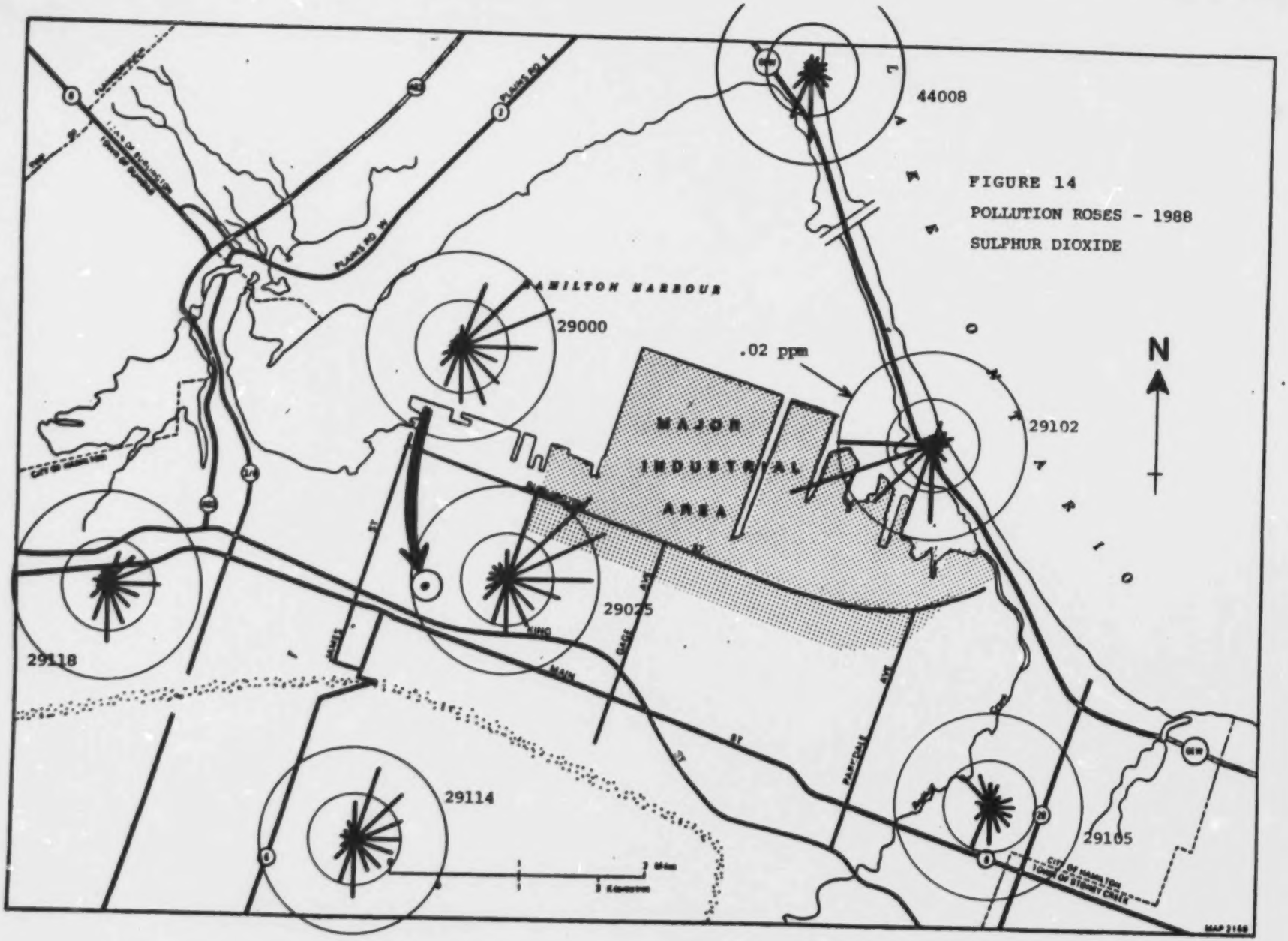


FIGURE 14
POLLUTION ROSES - 1988
SULPHUR DIOXIDE

4.5 Total Reduced Sulphur

These gases are comprised of hydrogen sulphide (H_2S), the "rotten egg" gas and other sulphur compounds and the mixture is referred to as total reduced sulphur (TRS). There are no general objectives for TRS. However, an hourly objective for H_2S of .20 ppb may be compared to the observed values since most emissions are thought to consist mainly of H_2S. The data given in Table 7 are also compared to the 10 ppb level - an approximate odour threshold for H_2S. TRS was measured at four stations - Barton, Elgin, Beach and the mountain.

The major sources of hydrogen sulphide and related sulphur compounds are the steel industry's coke ovens and related by-products operations, certain slag quenching processes, a tar plant and under upset conditions, a local manufacturer of carbon black. The sewage treatment plant is another potential source of odours but only during upset conditions.

In 1988, levels remained relatively similar to 1987 following the dramatic improvements recorded in that year. This improvement was related to Stelco Inc. replacing direct contact coolers in the coke oven by-product area with indirect coolers in April, 1987. The Barton station measured only 20 hours above 10 ppb (last seven months) in 1988 compared to 106 hours in 1986. The mountain station measured only 26 such hours (all in the moderate range of the AQI) in 1988 compared to 46 hours in the final 3 months of 1986, when the instrument was first installed. The new Elgin/Kelly station downtown commenced TRS measurements in February 1987 and measured only 18 hours over 10 ppb in 1988, all in the moderate range of the AQI.

Figure 15 displays the trend of 10 ppb exceedences per year at the Barton and Beach stations. The Barton station clearly shows a decreasing trend during the 1980's with a dramatic decrease observed in 1987.

A gradual decline is also evident in the graph for Beach Blvd. but that location did not show improvements in recent years. In fact, levels have been increasing since 1985. It is worth noting that the station was moved 1 km south, closer to Dofasco in 1985 and more in line with prevailing winds from that company. Stelco's effect on the Beach is limited by distance. The Beach station recorded 234 hours over 10 ppb in 1988 compared to 134 hours in 1987. Hourly data indicate that Dofasco Ltd. was the prime source affecting the Beach station. That company has been experimenting with methods of reducing emissions from slag quenching. The Carbochem plant and Stelco also affected the Beach area but to a much lesser degree. Those companies are now operating under Control Orders.

Not surprisingly, the TRS pollution roses for the four stations given in Figure 16 point strongly toward the industrial area. New analysis techniques involving the use of five minute averaged data now permit back-tracing of odorous levels, assisting in locating the sources of the elevated ambient concentrations. This will allow the Ministry to plan the most effective abatement strategies.

In addition to the Carbochem Control Order, the Ministry will continue to work with both Stelco and Dofasco to further reduce their TRS emissions.

TABLE 7

TOTAL REDUCED SULPHUR

UNITS - PARTS PER BILLION

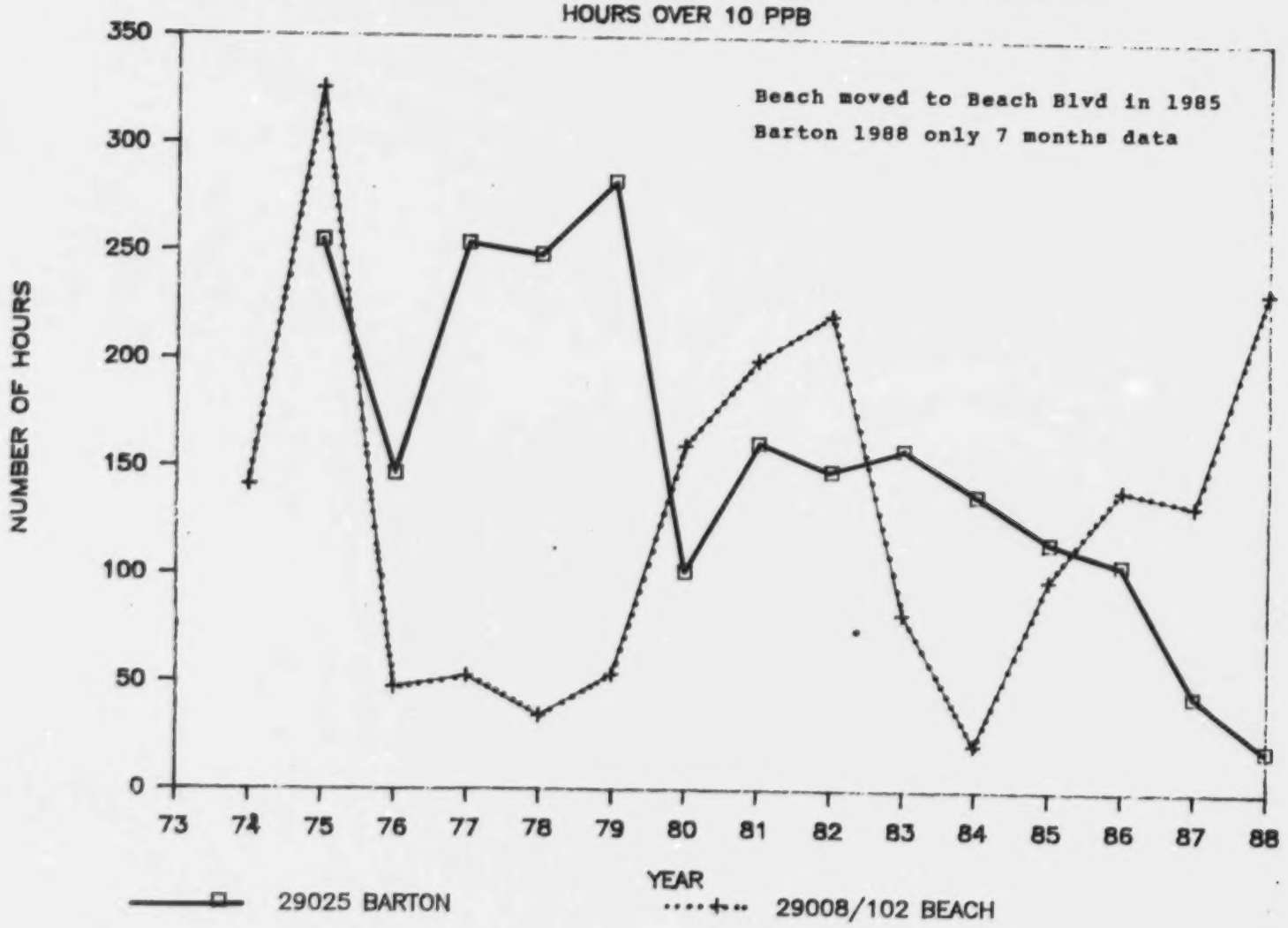
Ontario Objective: 1-hour - 20 (Hydrogen Sulphide)

		Annual Average	Maximum	Number of Hours Above 10ppb	Number of Hours Above 20ppb
29000 - Elgin/Kelly	1988	0.8	21	18	1
	1987	0.8[11]	14	12	0
29102 - Beach Blvd.	1988	2.5	54	234	30
	1987	1.6	33	134	15
	1986	1.3	42	141	18
	1985	1.0	37	99	15
29025 - Barton/ Sanford	1988	0.9[7]	16	20	0
	1987	0.9	30	45	6
	1986	1.4	64	106	12
	1985	1.4	56	116	16
29114 - Vickers/ East 18th	1988	1.2	17	26	0
	1987	0.8	19	21	0
	1986	0.9[3]	24	42	4

[11] - Numerical exponent refers to number of months sampled when less than 12.

FIGURE 15

TRS EXCEEDENCE TREND – HAMILTON



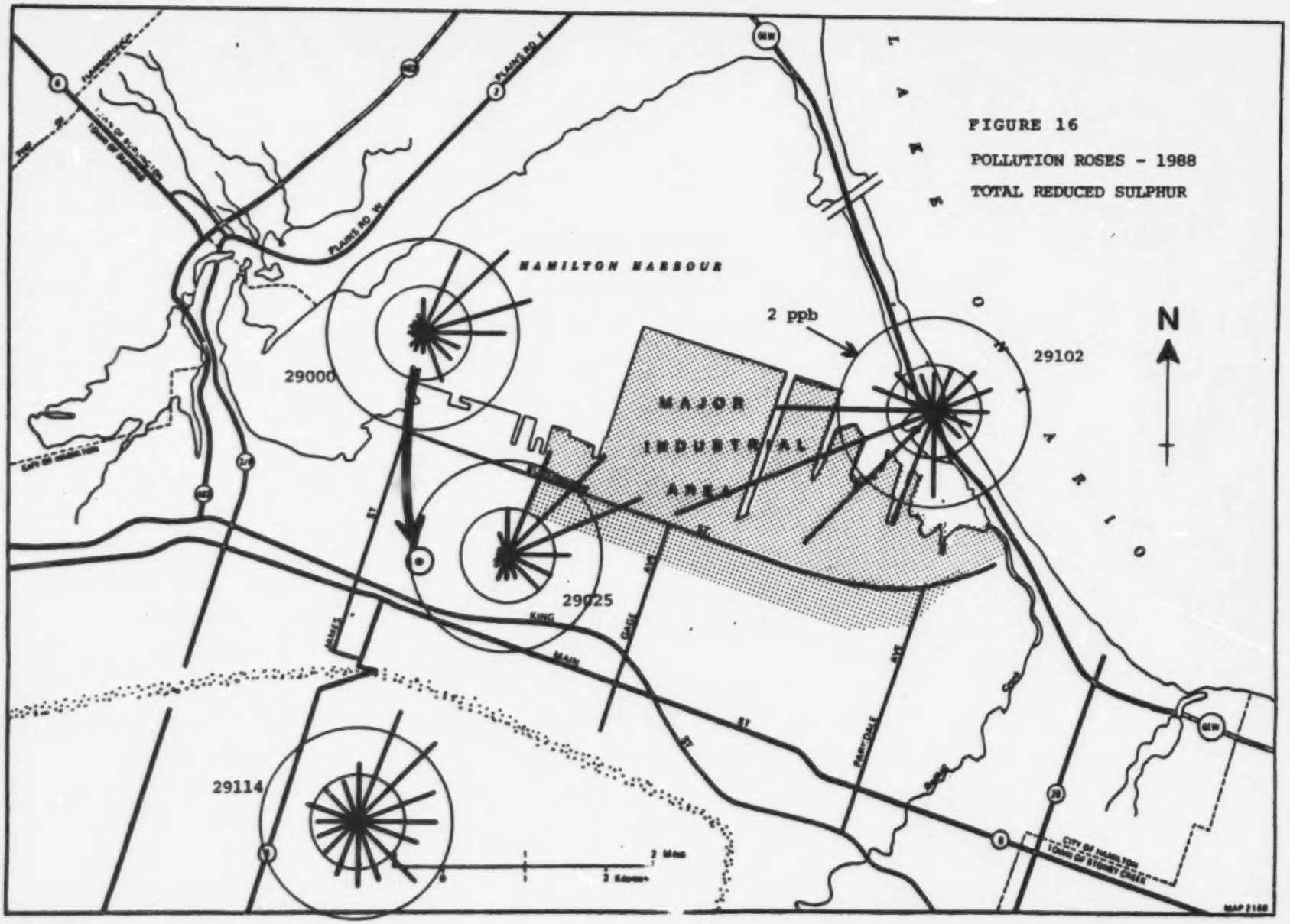


FIGURE 16
POLLUTION ROSES - 1988
TOTAL REDUCED SULPHUR
HAMILTON HARBOUR
2 ppb
29000
29102
29025
29114
MAJOR
INDUSTRIAL
AREA
N

4.6 Carbon Monoxide

The major source of carbon monoxide is the automobile although there are also some contributions from industry. Due to automotive emission controls, the levels measured at Barton Street (moved to Elgin/Kelly in 1987) decreased greatly since the 1970's (Figure 17). In 1988, the levels were similar to the previous few years and were well below the objectives which are based on health effects. Data are given in Table 8. All downtown and Burlington AQI readings (both 1-hour and 8-hour) fell in the very good range.

A carbon monoxide analyzer was installed in the North Park station in January 1984. Concentrations at North Park throughout 1984 and at Beach Blvd. in 1985-88 were lower than at Barton Street and Elgin, explained by the fact that the high speed traffic on the QEW generates less carbon monoxide than the low speed traffic on Barton Street[3], and that the Beach Blvd. traffic load is much less than Barton Street - almost half[4]. Concentrations did increase somewhat in 1988 at Beach. In Burlington, levels were comparable to the Beach station.

The pollution roses given in Figure 18 indicate that concentrations at the new Elgin/Kelly and Burlington stations were uniform for all wind directions, while Beach Blvd.'s highest averages (albeit very low) were from the southwest.

TABLE 8

CARBON MONOXIDE

UNITS - PARTS PER MILLION

Ontario Objective: 1-hour - 30
8-hour - 13

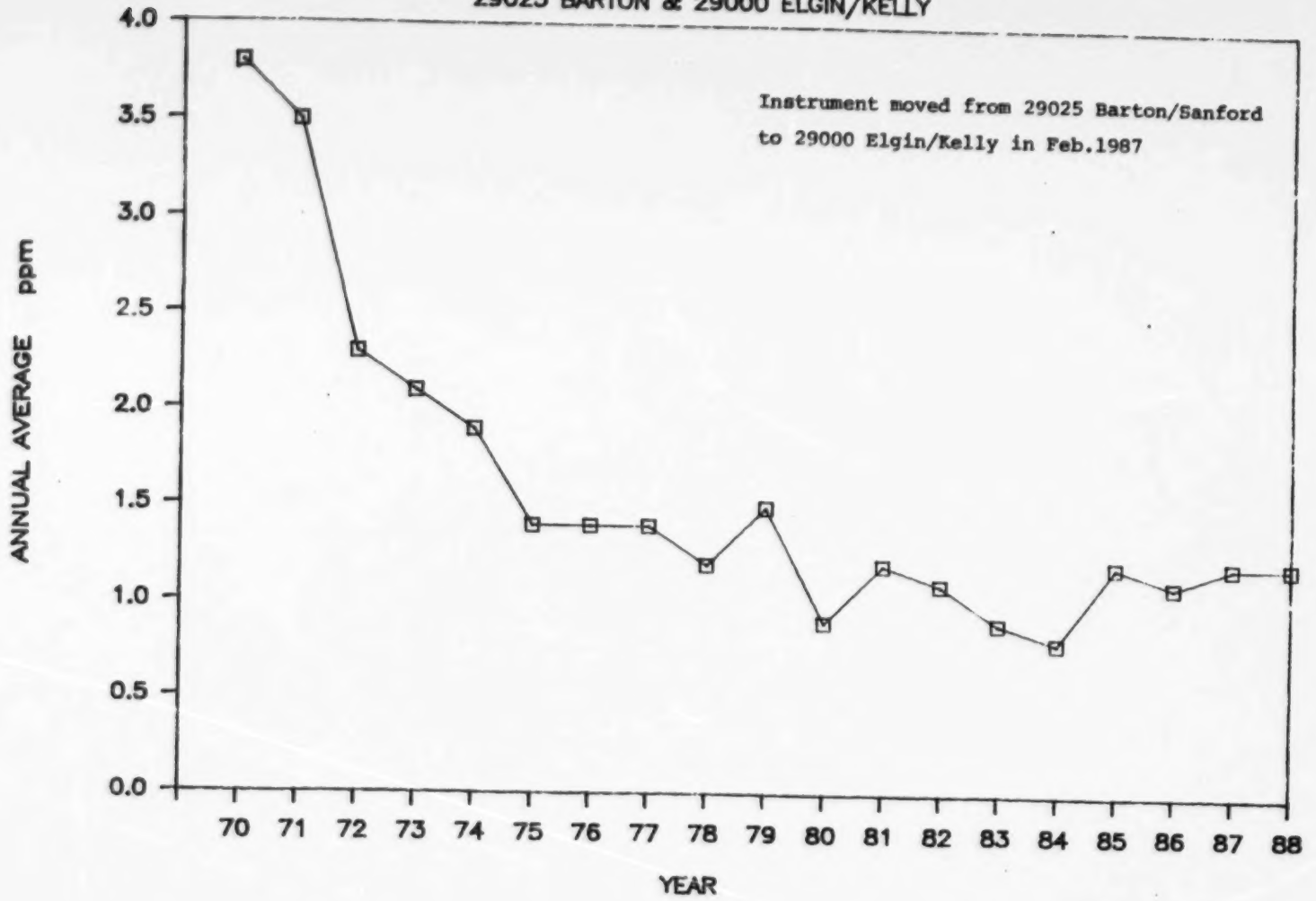
		Annual Average	Maximum 1-hour	Maximum 8-hour	No. of Times Above Objective 1-hour	No. of Times Above Objective 8-hour
29102 - Beach Blvd.	1988	0.7	12	3	0	0
	1987	0.3	10	3	0	0
	1986	0.3	7	2	0	0
	1985	0.3	7	3	0	0
29000 - Elgin/Kelly	1988	1.2	11	5	0	0
29025 - Barton/	1987*	1.2	8	5	0	0
Sanford	1986	1.1	12	6	0	0
	1985	1.2	10	4	0	0
44008 - Hwy 2/N.Sh.	1988	0.7	12	3	0	0
Burlington	1987	1.0	9	5	0	0
	1986	1.0	11	4	0	0
	1985	1.1	7	3	0	0

*29025 moved to 29000 in February 1987.

FIGURE 17

CARBON MONOXIDE YEARLY TREND

29025 BARTON & 29000 ELGIN/KELLY



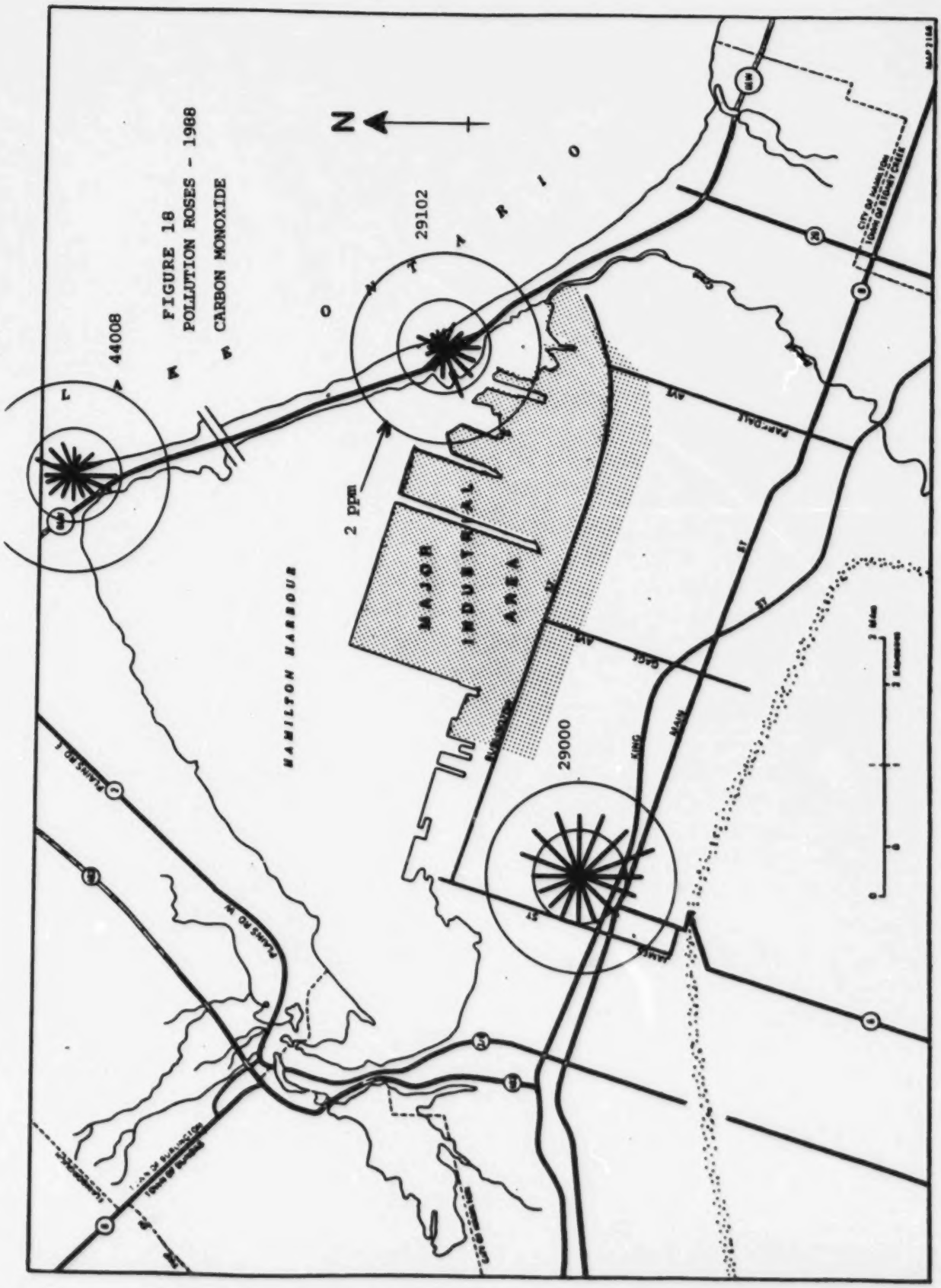


FIGURE 18
POLLUTION ROSES - 1988
CARBON MONOXIDE
N
ONTARIO
44008
29102
29000
2 ppm
MAJOR INDUSTRIAL AREA
HAMILTON HARBOUR
Parkdale Ave
Barton St
King St
James Rd N
James Rd S
3 Miles
3 Kilometres

4.7 Oxides of Nitrogen

The primary source of oxides of nitrogen are high temperature combustion sources including the automobile. The most abundant oxides are nitric oxide (NO) and nitrogen dioxide (NO_2). Nitric oxide is a direct emission which is then oxidized in the atmosphere to form nitrogen dioxide. Both pollutants were monitored continuously at Elgin/Kelly, Main West, Beach Blvd. and Burlington. At each station, a single instrument makes measurements of NO, NO_2 and total nitrogen oxides. Nitric oxide is measured directly, and the total oxides are measured by internally converting all other nitrogen oxides to nitric oxide. The instrument then determines nitrogen dioxide to be the difference between the first two measurements.

Objectives exist only for nitrogen dioxide and these are based on odour threshold levels (hourly) and health effects (24-hourly). Other adverse effects occurring at much higher levels include vegetation damage, reduced visibility and corrosion of metals. The objectives were not exceeded in 1988, similar to previous years.

Data for nitrogen dioxide are given in Table 9 and yearly trends since 1975 are illustrated in Figure 19. Both Barton and Beach stations showed similar concentrations to previous years and similar to the west end site 29118 on Main Street West, and the Burlington station. A leveling off in concentrations at the two established stations is evident although a small decline is still occurring.

Data for nitric oxide are given in Table 10 and yearly trends for Beach and Barton (moved to Elgin) are given in Figure 21. Note the abrupt decrease in levels at Beach following the move to 29102 in 1985. The station is now much less affected

by vehicle emissions. The new Main Street West site recorded higher levels in 1988 than the other three; it is being affected by traffic on Main Street West and the Highway 403 cutoff.

Pollution roses for the two measurements are given in Figures 20 and 22. The roses for NO_2 (Figure 20) do not indicate a dominant directional influence. It is clear from Figure 22 that NO levels at all stations were due mostly to traffic.

Highest NO levels were measured at 29118 (Main West), and the largest peaks point towards the Highway 403 cutoff and Main Street West. Elgin/Kelly also shows highest levels for southeast/northeast, probably from Wilson and Cannon Streets. The southwest peaks for 29102 (Beach Blvd.) point mainly to Beach Blvd. and the QEW, although the industries are also upwind, while Burlington's small peaks point at the QEW.

Oxides of nitrogen are also an important factor in the photochemical cycle of ozone in the atmosphere. This will be discussed in the next section of this report.

TABLE 9

NITROGEN DIOXIDE

UNITS - PARTS PER MILLION

Ontario Objectives: 1-hour - .20
24-hour - .10

		Annual Average	Maximum 1-hour	Maximum 24-hour	No. of Times Above Objective 1-hour	No. of Times Above Objective 24-hour
29102 - Beach Blvd.	1988	.025	.11	.06	0	0
	1987	.022	.11	.06	0	0
	1986	.023	.12	.12 .05	0	0
	1985	.023	.08	.06	0	0
29000 - Elgin/Kelly	1988	.024	.13	.07	0	0
	1987*	.027	.16	.06	0	0
29025 - Barton/ Sanford	1986	.027	.10	.07	0	0
	1985	.025	.11	.06	0	0
29118 - Main W./ Hwy. 403	1988	.021	.11	.06	0	0
	1987	.018	.10	.07	0	0
	1986	.018	.12	.08	0	0
	1985	.019[6]	.08	.04	0	0
44008 - Hwy 2/N.Sh. Burlington	1988	.023	.15	.05	0	0
	1987	.021	.11	.07	0	0
	1986	.021	.09	.05	0	0
	1985	.025	.09	.06	0	0

6 - Six months of sampling (July - December).
* - 29025 moved to 29000 in February 1987.

TABLE 10

NITRIC OXIDE

UNITS - PARTS PER MILLION

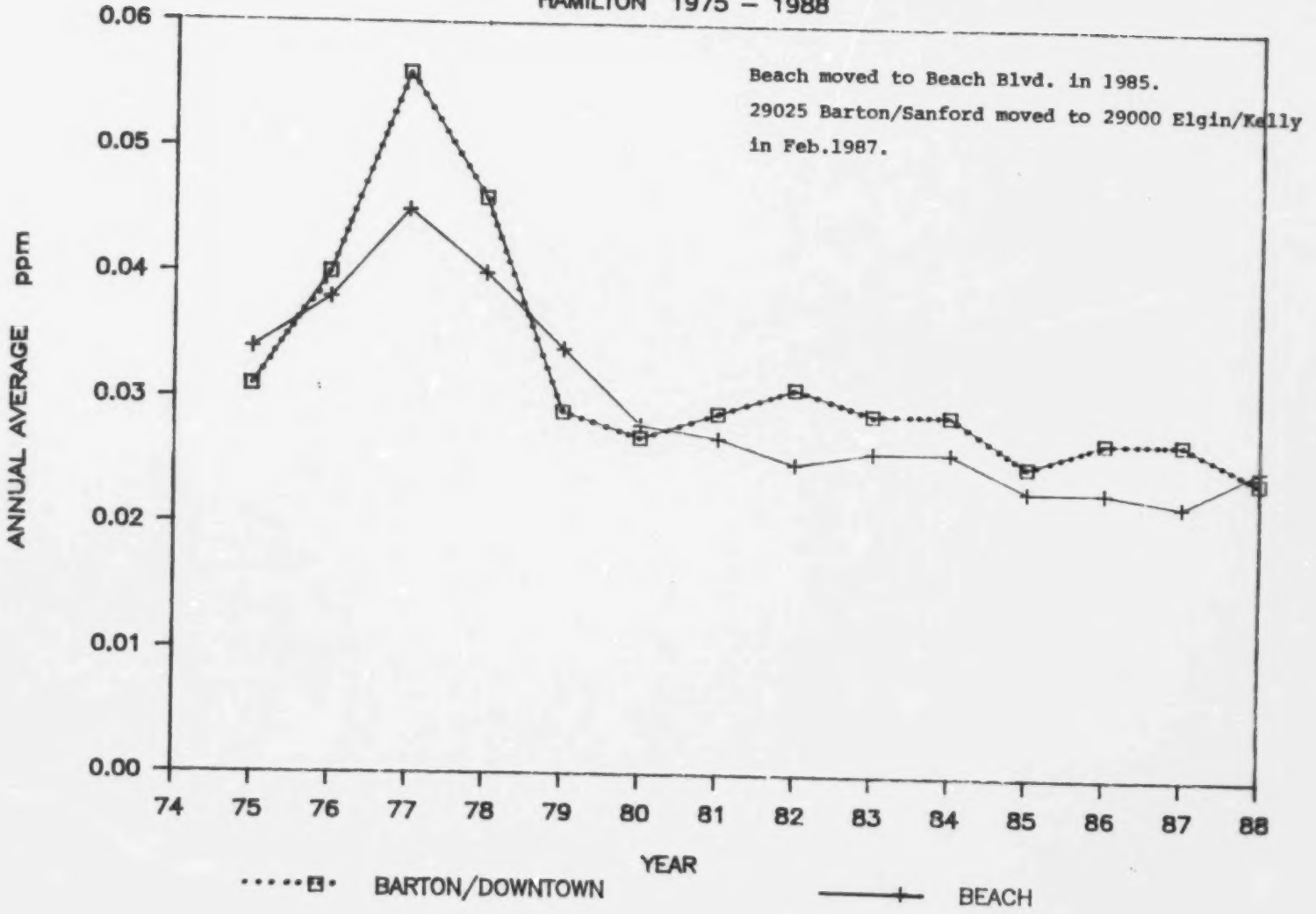
		Annual Average	Maximum 1-hour	Maximum 24-hour
29102 - Beach Blvd.	1988	.023	.31	.12
	1987	.021	.42	.14
	1986	.023	.47	.23
	1985	.020	.51	.09
29000 - Elgin/Kelly	1988	.017	.56	.23
29025 - Barton/	1987*	.017	.47	.15
Sanford	1986	.021	.50	.15
	1985	.019	.51	.11
29118 - Main W./	1988	.031	.91	.24
Hwy. 403	1987	.034	.57	.22
	1986	.029	.53	.20
	1985	.033[6]	.92	.15
44008 - Hwy 2/N.Sh.	1988	.018	.48	.13
Burlington	1987	.023	.62	.22
	1986	.020	.64	.13
	1985	.026	.73	.13

6 - Six months of sampling (July - December).
* - 29025 moved to 29000 in February 1987.

FIGURE 19

NITROGEN DIOXIDE YEARLY TREND

HAMILTON 1975 – 1988



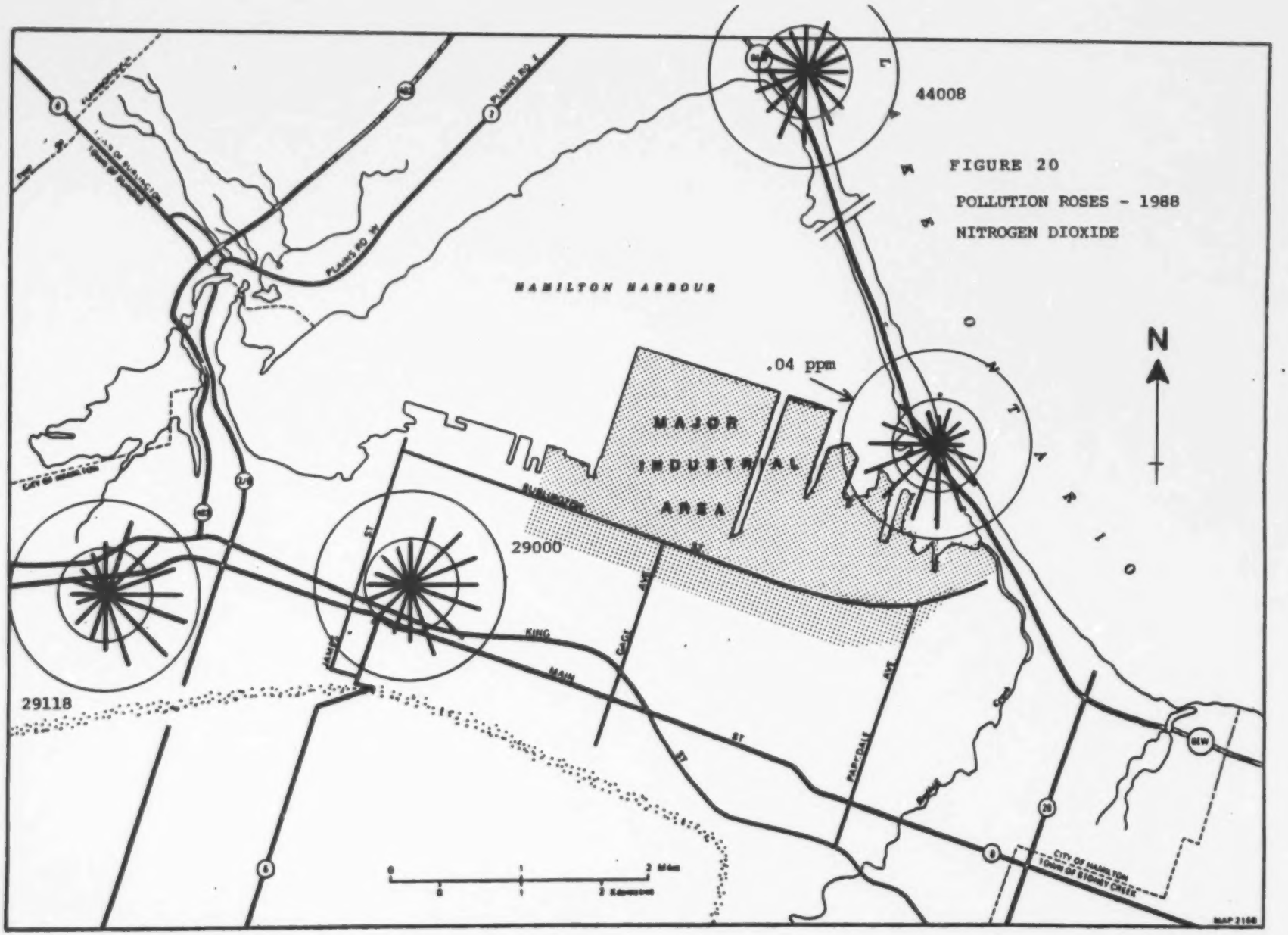


FIGURE 20

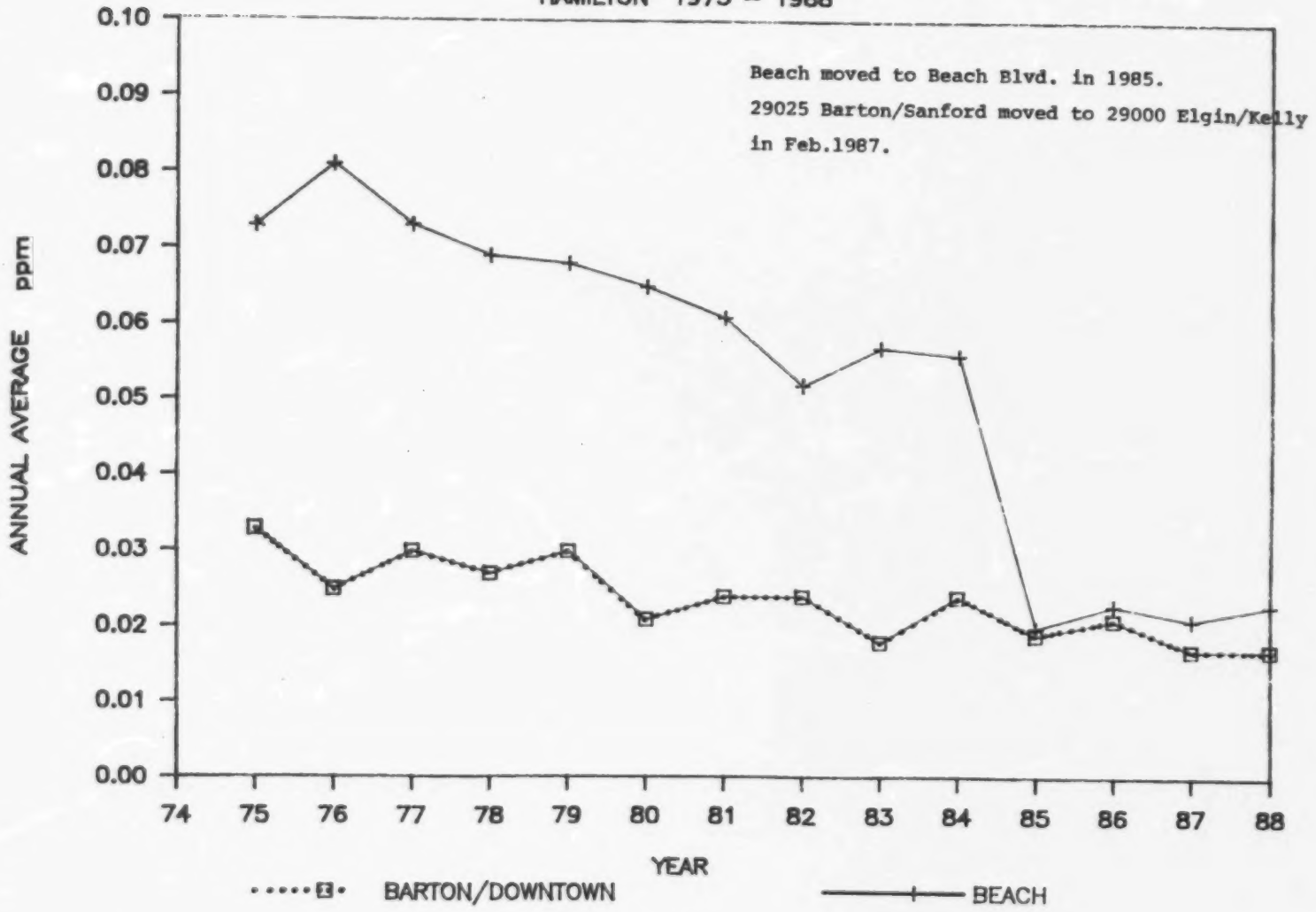
POLLUTION ROSES - 1988

NITROGEN DIOXIDE

FIGURE 21

NITRIC OXIDE YEARLY TREND

HAMILTON 1975 – 1988



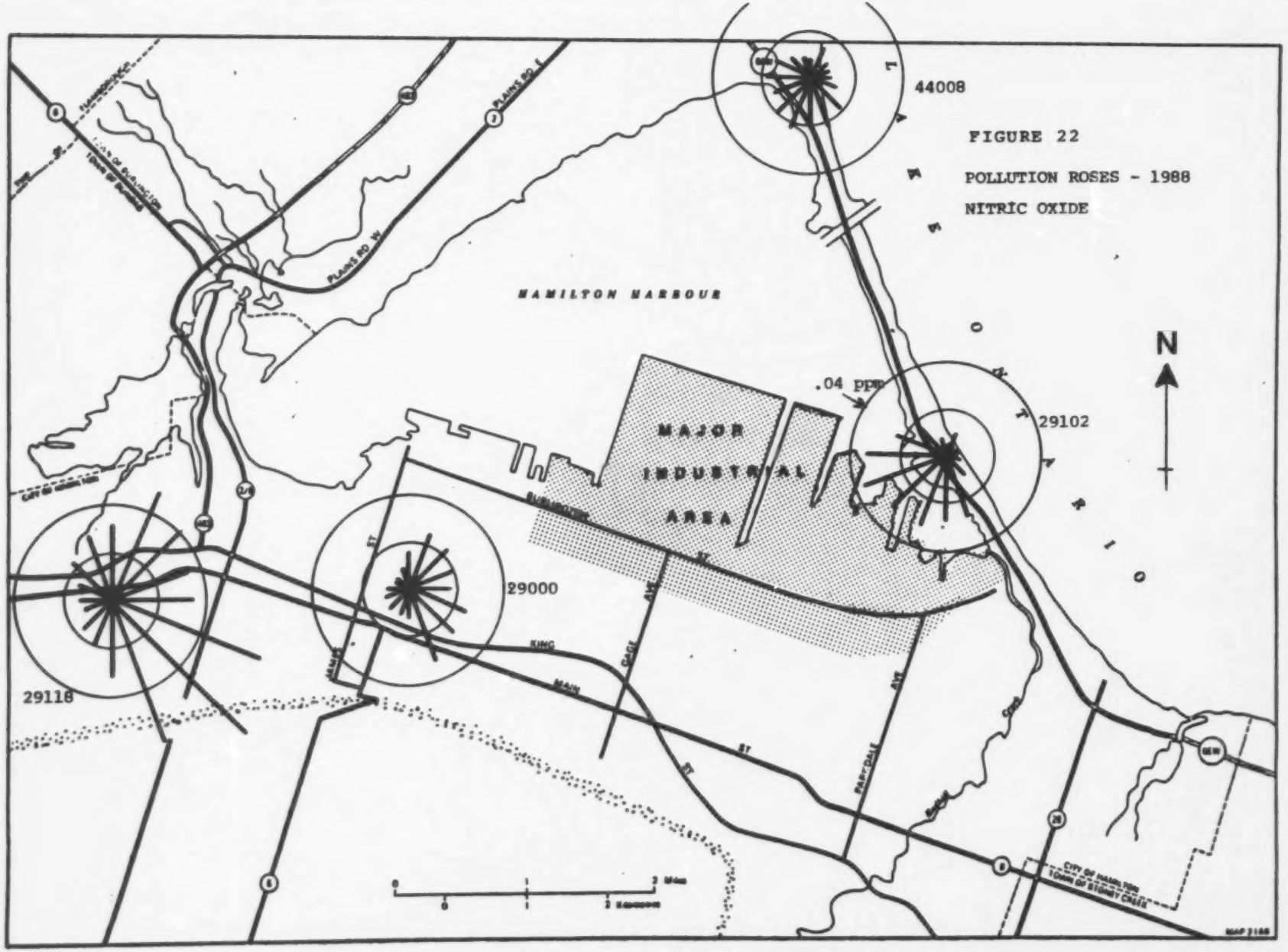


FIGURE 22

POLLUTION ROSES - 1988

NITRIC OXIDE

4.8 Ozone

Oxidants are produced by photochemical reactions involving oxides of nitrogen, hydrocarbons and sunlight. Ozone accounts for most of the oxidants produced. The sources of the precursor pollutants are mainly industrial and automotive. The rate of oxidant production is dependent on the quantity of precursor pollutants, temperature and intensity of sunlight.

Ozone is known to cause respiratory problems, and at very elevated concentrations, people can experience adverse health effects. Ozone is also injurious to different types of vegetation including certain tobacco, bean and tomato crops. The one-hour objective for ozone (80 ppb) is based on such vegetation effects.

Ozone concentrations follow very definite annual and daily trends. Highest levels occur during the summer (May - September), and the daily maxima usually occur during late afternoon. Both patterns are directly related to temperature and the amount and intensity of sunlight.

Ozone was measured at the Elgin/Kelly station, at the east site 29105 (Nash/Kentley), the west site 29118 (Main West), mountain station 29114 (Vickers/E 18th) and Burlington 44008 (North Shore Blvd.). Data is summarized in Table 11 while yearly trends at Elgin/Kelly are illustrated in Figure 23.

In 1988, due to an extremely hot summer, levels were much higher than previous years and fairly uniform City-wide. The hourly objective of 80 ppb was exceeded in a range from 108 to 196 hours at the four Hamilton stations. Most of these readings fell in the moderate range of the AQI but 5-10 hours fell in the poor range at all stations. Somewhat surprisingly, the Main West site recorded the most exceedences, despite the fact it is much more prone to ozone

depletion by vehicle traffic exhaust. However, the station is located at an Ontario Hydro transformer facility and the nearby overhead high tension wires are suspected of producing ozone. Studies are being carried out on this phenomenon. The Burlington station showed another surprising result by recording only 37 hours over the hourly standard similar to previous years. All other stations in Southern Ontario showed extreme increases in 1988. Burlington's lack of the same trend is unexplained, except for the possibility that the Hamilton industrial zone which lies upwind on these occasions acted as a scavenger of ozone.

During each elevated ozone episode, winds were southwest and warm temperatures prevailed. The origin of the ozone is believed to be the United States. This is confirmed by stations close to the shore of Lake Erie. One such station at Long Point, upwind of all Canadian sources, measured over 560 hours above the objective, the most in the Province.

The pollution roses in Figure 24 confirm that highest concentrations occurred under winds from the southwest quadrant. The peaks from these directions are not overly prominent because southwest winds do not automatically yield high ozone levels even during the summer. Low temperatures, lack of precursor pollutants or absence of direct sunlight all reduce ozone formation.

Ozone, hydrocarbons and oxides of nitrogen can be transported over great distances and can be augmented by local sources. However, Hamilton and other major urban areas usually experience lower ozone concentrations than their more rural surroundings during peak occurrences due to the numerous high temperature combustion sources which produce scavengers of ozone such as nitric oxide. Nonetheless, ozone and other oxidants remain a problem in the Hamilton area. Due to the complexity of oxidant formation and the long range transport phenomenon, this problem will have to be resolved on a national and international rather than local scale.

TABLE 11

OZONE

UNITS - PARTS PER BILLION

Ontario Objective: 1-hour - 80

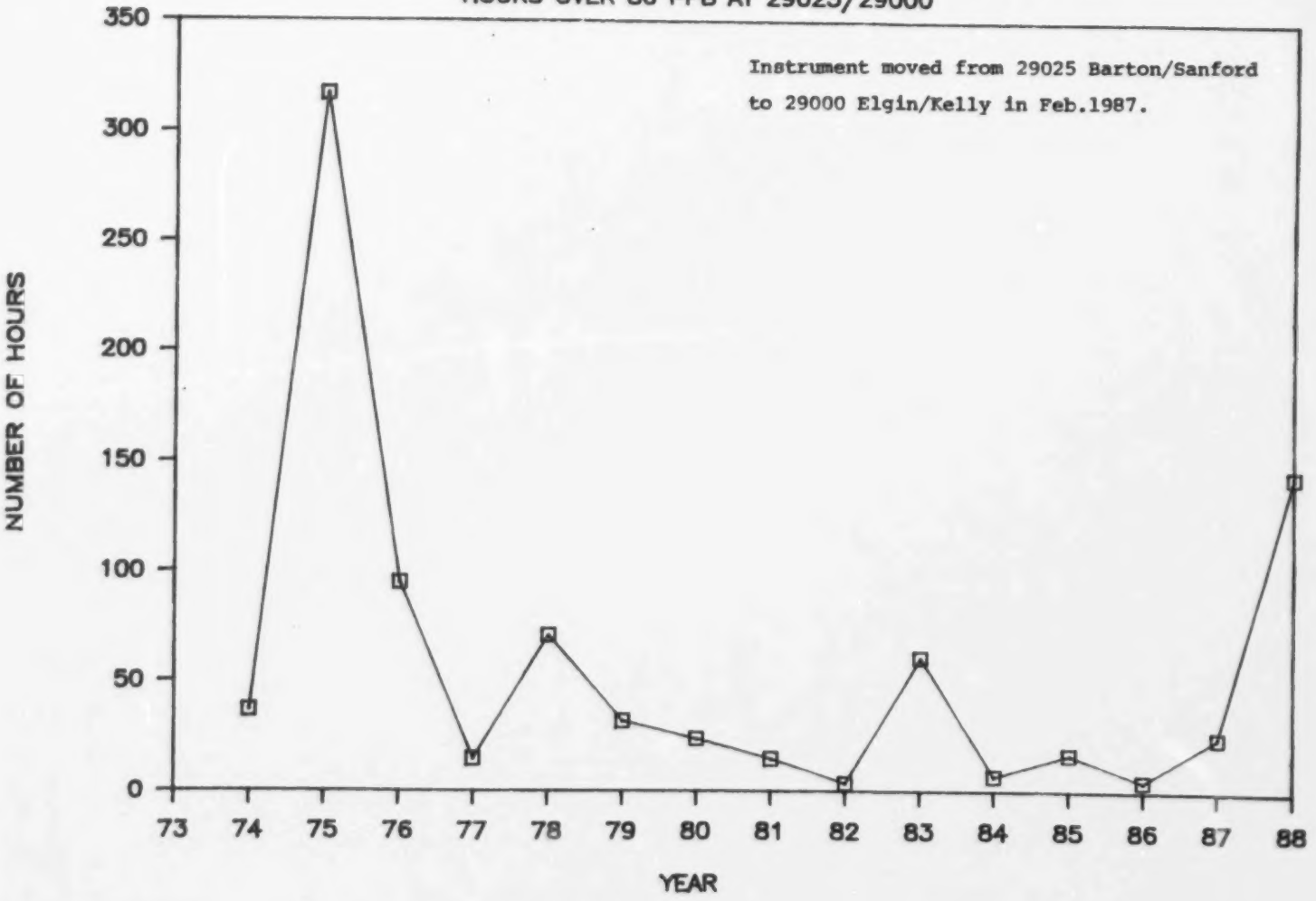
		Annual Average	Maximum - 1 hour	No. of Hours Above Objective
29025 - Barton/ Sanford	1988	17.9	137	144
	1987*	15.2	105	24
29000 - Elgin/Kelly	1986	16.3	88	5
	1985	19.0	96	17
29105 - Nash/ Kentley	1988	20.6	132	108
	1987	19.2	111	69
	1986	19.2	96	11
	1985	23.0[11]	104	23
29114 - Vickers/ East 18th	1988	19.8	131	156
	1987	19.8	114	85
	1986	20.1	94	34
29118 - Main W./ Hwy. 403	1988	18.3	135	196
	1987	14.3	103	36
	1986	15.0	85	3
	1985	17.9[6]	99	23
44008 - Hwy 2/N.Sh. Burlington	1988	18.2	151	37
	1987	19.7	167	41
	1986	19.8	99	46
	1985	20.8	115	19

[11] - Numeric exponent refers to number of months sampled when less than 12.
* - 29025 moved to 29000 in February 1987.

FIGURE 23

OZONE EXCEEDENCE TREND

HOURS OVER 80 PPB AT 29025/29000



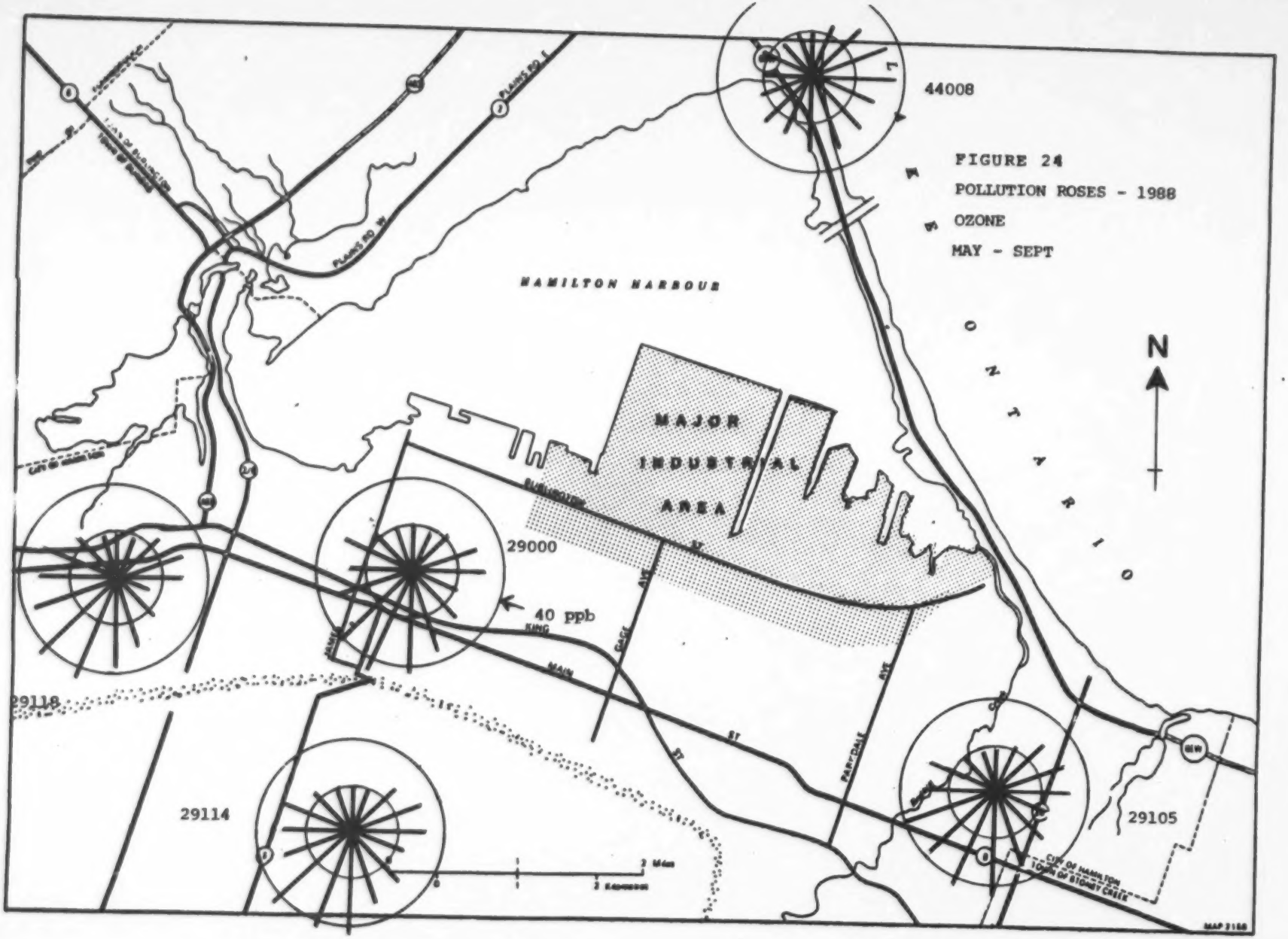


FIGURE 24
POLLUTION ROSES - 1988
OZONE
MAY - SEPT

4.9 Fluoridation

This measurement is a relatively crude assessment used to determine quantities of various fluoride compounds in the ambient air. A lime coated paper is exposed to the atmosphere for one month and is then chemically analyzed for fluoride. The fluoride objectives are based on vegetation damage and for this reason, the objective is more stringent during the growing season. For the period of April 15 to October 15, it is 40 micrograms/100 square centimeters/30 days while for the remainder of the year it is 80.

In Hamilton, the major fluoride sources are the basic oxygen furnaces used by the major steel industries which require fluorspar as a fluxing agent and a brick manufacturing plant at the base of the escarpment near Gage Park. In addition to these process emissions, there are other minor sources such as coal burning, since coal contains trace amounts of fluoride.

Data for 1988 are summarized in Table 12 and the yearly trend since 1970 is illustrated in Figure 25.

The trend graph shows that while levels were declining gradually during the 1980's following large reductions in concentrations which began in 1971, an upturn in concentrations was observed in both 1986 and 1987. In 1988, levels reduced once again.

A contour plot of yearly averages is given in Figure 26. A ring can be drawn around the industrial area as shown. The worst station within this area recorded 6 samples above the monthly objectives. However, past Phytotoxicology Assessment Surveys indicated that fluoride injury to silver maple foliage (a sensitive indicator species) in this area was only in very small amounts.

The most prominent individual source of airborne fluoride in the city is the Hamilton Brick Co., near Gage Park. A network of five monitors was established there in 1988 and recorded high levels well above objectives.

Elevated fluoride concentrations near brick plants are common. A 1983 report undertaken jointly by the Ontario Ministries of Environment, Health and Labour concluded that "the maximum additional intake of fluoride resulting from exposure to brick plant fluoride emissions is small. It is concluded that this additional intake could be considered to fall within the normal range of fluoride intake from dietary sources and as such would not be expected to induce health effects in an exposed population" (p. 24). This report was based on measurements near a Toronto and a Brampton brick plant. Concentrations in Toronto and Brampton were comparable to those measured at the Hamilton stations.

Although human health concerns are not a problem, light to moderate injury to sensitive vegetation (mostly silver maple) was discovered in the vicinity of the plant in 1986. Injury and fluoride concentrations in the vegetation decreased with distance from the brick plant. The maximum fluoride concentration measured in plant tissue in 1986 was 820 ug/g, well above the guideline of 35. In contrast, the maximum fluoride level measured in the industrial area was only 60 ug/g in the regular 1987 survey. A survey was not conducted in 1988.

The Hamilton Brick Co. has upgraded their drying ovens and reduced the temperatures used in the process in conjunction with the installation of more efficient kilns. These modifications should result in a reduction of fluoride levels surrounding the plant. The Ministry is continuing abatement activities with the company in an attempt to further reduce emissions to an acceptable level.

TABLE 12
FLUORIDATION RATE - 1988

ALL VALUES IN MICROGRAMS/100 SQ. CM/30 DAYS

Ontario Criteria - Apr. 15 to Oct. 15 - 40
Oct. 15 to Apr. 14 - 80

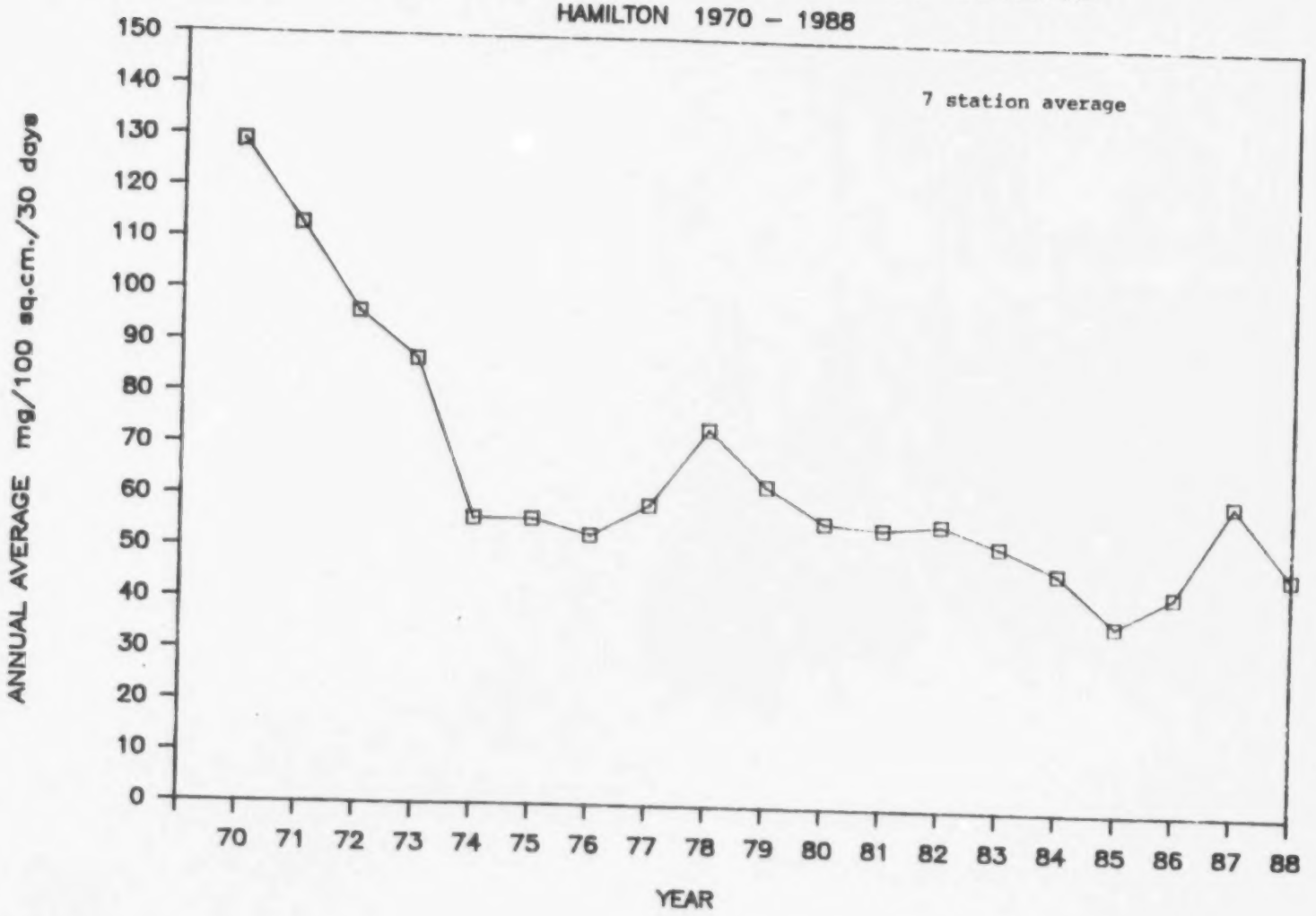
	Annual Average 1986	1987	1988	Maximum 1988	Number of Months Above Objective 1988
29001 Hughson/Hunter	28	38	30	42	1
29012 Burlington/Wellington	22	40	24	36	0
29025 Barton/Sanford	40	54	40	64	3
29054 Beach Rd./Conrad	44	79	53	81	5
29059 Burlington/Gage	59	89	63	79	6
29062 Briarwood School/ King St. E.	54	64	57	89	5
29066 Killarney/Beach Blvd.	54	64	59	89	5
29115 London/Justine	269^{11}	190^{4}	206^{9}	294	9
29116 Dalkeith/Ottawa	59^{11}	94	66	80	6
29119 Morley/Parkdale	45^{11}	52	42	53	3
29120 Dickson/Burlington	64^{11}	77	45	66	4
29126 Rosslyn/Montclair	-	-	167^{9}	332	7
29127 Lawrence/Balmoral	-	-	998^{9}	1675	7
29129 Province/Justine	-	-	103^{9}	191	9
29131 Central/Graham	-	-	84^{9}	109	8

^{11} - Numeric exponent refers to number of months sampled when less than 12.

FIGURE 25

FLUORIDATION RATE YEARLY TREND

HAMILTON 1970 – 1988



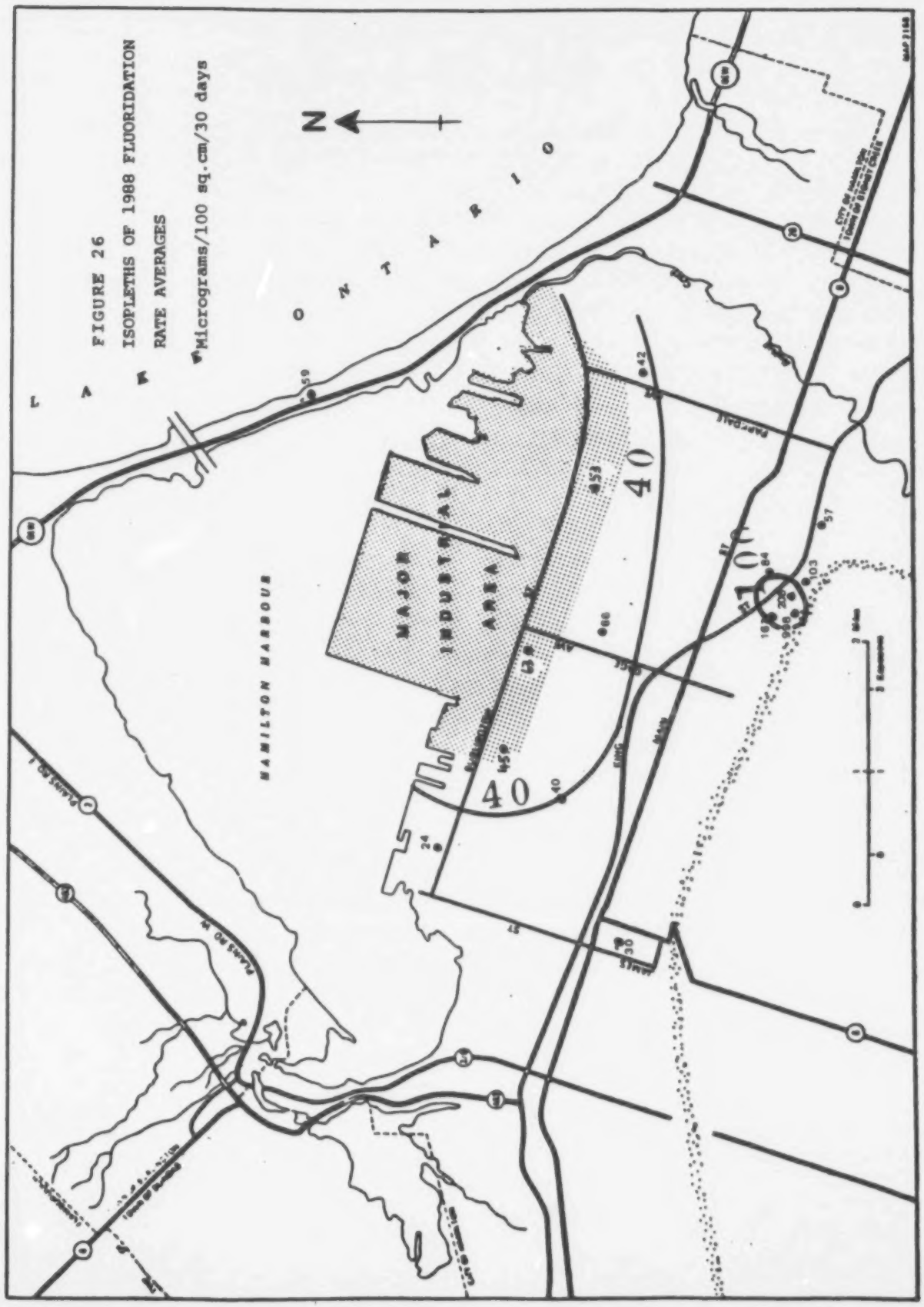


FIGURE 26
ISOPLETHS OF 1988 FLUORIDATION
RATE AVERAGES
Micrograms/100 sq.cm/30 days
N
ONTARIO
LAKE
MAJOR
INDUSTRIAL
AREA
HAMILTON HARBOUR
40
40
40

5. AIR MONITORING NEAR STEETLEY INDUSTRIES

In addition to the network in the City of Hamilton, the Ministry has been monitoring airborne dust levels near Steetley Industries, a limestone quarry operation near Greensville in the Town of Flamborough since 1974. Four dustfall jars have been in place continuously since that time. Two additional jars were added in 1982 when the quarry expanded, and another jar was added in 1988. In addition, beginning in 1986, hi-vol sampling for suspended particulates was undertaken at the Westfield Academy on Ofield Road South, just northeast of the company's processing plant at station 29111. A second hi-vol (29112), was installed in the village of Greensville in mid-1987. A map of the station locations is given in Figure 27.

The 1988 suspended particulate data at station 29111 - Westfield, indicated a sometimes severe localized problem with airborne dust. The annual geometric mean of 110 ug/m^3 was well above the yearly objective of 60 and 23 out of 56 samples exceeded the daily objective of 120. All data are summarized in Table 13.

The Westfield data were severely affected by construction activities. An addition was built onto the Academy starting in the summer of 1988 and this generated much fugitive dust. The TSP data were correlated against wind direction frequency and no direction dominated with a positive correlation, unlike 1987 data when southwest winds from Steetley did show a correlation. The construction activities thus clearly affected the samples making Steetley's contribution unclear.

Further away in the village of Greensville at station 29112, the levels were much lower. The geometric mean was well below the annual objective and only 2 samples out of 48 exceeded the daily objective. Only one of these two readings could be ascribed to Steetley. The other may have been related to winter road sanding operations. However, the samples were analyzed for carbonate (limestone is calcium carbonate) and these levels did correlate positively with northerly wind direction frequency, suggesting some effect of Steetley.

Dustfall levels (also Table 13) in 1988 improved from 1987 at 5 of 6 stations. Station 29073 at a restaurant on Highway 5 just northeast of the quarry continued to yield the highest concentrations, almost double the other stations, and eight samples exceeded the monthly objective. This restaurant's unpaved parking lot was suspected to be contributing to the readings. To ascertain this, a second jar (29273) was located close by in 1988, but removed from the parking lot near the corner of Ofield and Highway 5. As suspected, the readings at this location were much lower than the restaurant, with only one out of nine samples exceeding the objective. This one sample in July was heavily loaded and may have been caused by the construction activities at the Westfield Academy just south of the sampler.

Figure 28 gives the yearly trend of dustfall dating back to 1975 for the old four established locations. The restaurant station (29073) trend is given together with the combined average of the other three locations. The latter curve shows steady improvement since 1984 falling below the annual objective in 1988. The restaurant curve does likewise except for an upturn in 1987.

Quarry operations have moved north of the 4th Concession and this is reflected by station 29096 on Ofield Rd. N. Its yearly mean has been increasing since 1986 and measured six exceedences of the monthly objective in 1988.

In January 1987, Steetley installed a new electrostatic precipitator to control their #1 and #3 kilns. The emissions from these kilns were also directed into a single tall stack, eliminating a shorter stack and thus providing better dispersion of the remaining process emissions. In 1988, the company installed a conveyer system from the north quarry operations to the plant, eliminating truck traffic, a source of dust. A slurry system was also installed for disposal of precipitator dust by wet methods. Previously, this dust was trucked in dry form causing dust problems. As well, the company installed adjustable stackers reducing fugitive emissions from storage piles and in late 1989 the #3 feed stockpile will be enclosed. Steetley is also planning to install a new electrostatic precipitator, so that all three kilns will have their own separate precipitators. The dustfall data indicate these improvements are having a positive effect.

The remaining dust sources at Steetley's processing plant are the dry fines plant, and various fugitive dust sources such as stock piles, roads, portable crushers, and a large stone feed pile for the #3 kiln (to be housed in 1989). The latter pile is located only about 150 metres from the Westfield Academy hi-vol site.

TABLE 13

SUMMARY STATISTICS - GREENSVILLE

PARTICULATES NEAR STEETLEY QUARRY

SUSPENDED PARTICULATES - micrograms per cubic metre

ONT.OBJECTIVES: 120 (24 hour)
60 (annual geo.mean)

STATION	GEOMETRIC MEAN 1986	1987	1988	1988 MAXIMUM 24 HR	NO.OF SAMPLES	NO.TIMES OVER OBJECTIVE(1988) 24 HR	1 YR
29111 OFIELD S/HWY 5	100	89	110	1113	56	23	1
29112 HARVEST/WESITE	-	39	39	173	48	2	0

DUSTFALL - grams/square metre/30 days

ONT.OBJECTIVES : 7.0(1 MONTH)
4.5(ANNUAL AVERAGE)

STATION	ANNUAL AVERAGE 1986	1987	1988	1988 MAXIMUM 1 MONTH	NO.MONTHS OVER OBJECTIVE 1986	1987	1988
29073 - HWY 5/OFIELD	8.2	9.7	9.3	14.7	9	8	8
29273 - OFIELD/HWY 5	-	-	*6.1	29.7	-	-	1
29074 - OFIELD S	7.2	5.2	4.8	8.7	6	3	1
29075 - HARVEST RD	6.5	4.7	4.2	11.7	5	2	3
29076 - MELDRUM/WESITE	5.3	4.8	5.2	12.5	3	1	3
29096 - OFIELD N	4.8	5.2	6.6	11.1	0	3	5
29097 - 4TH CONCESSION	4.1	3.9	3.4	10.3	1	2	1

* 9 months of data

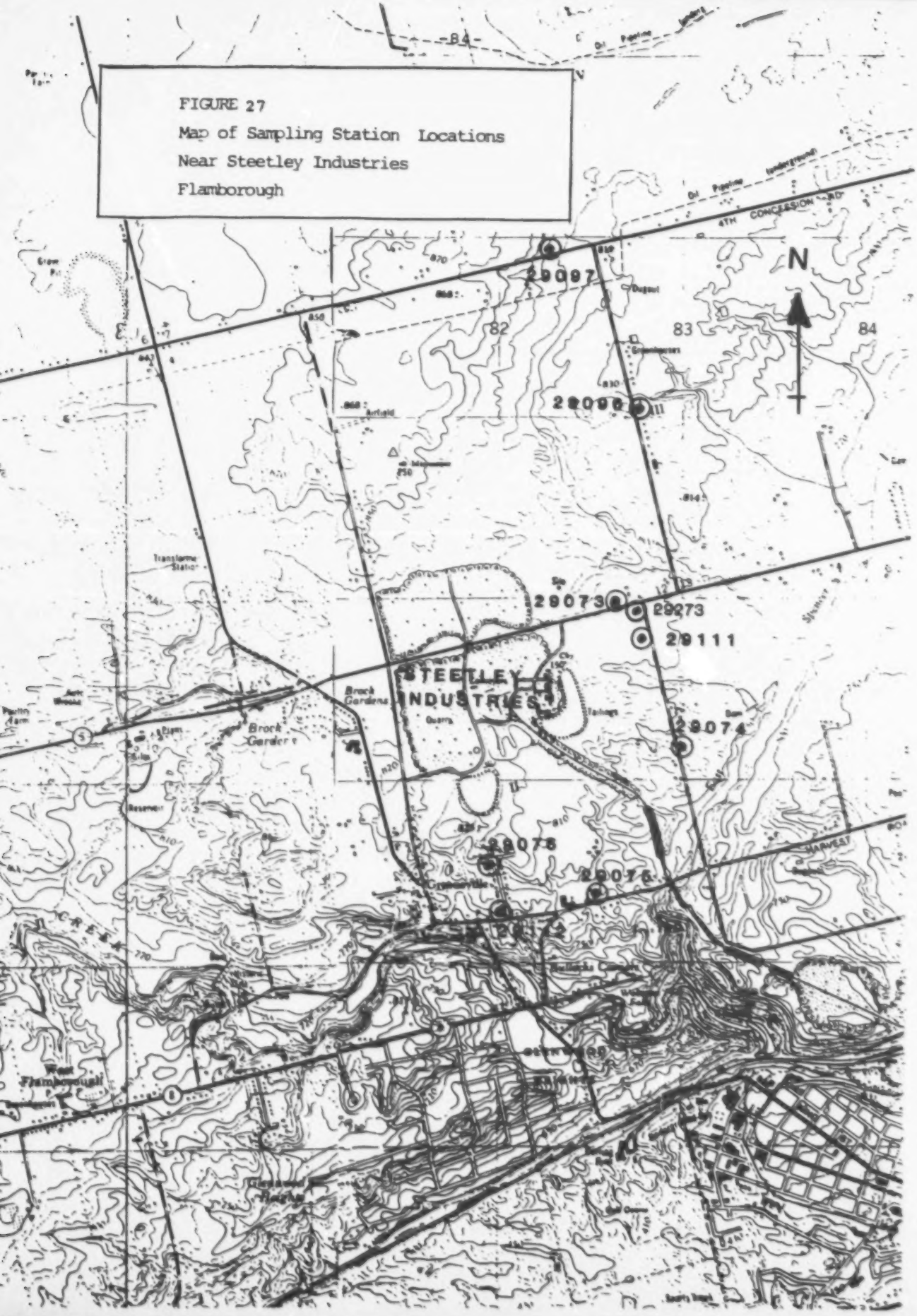
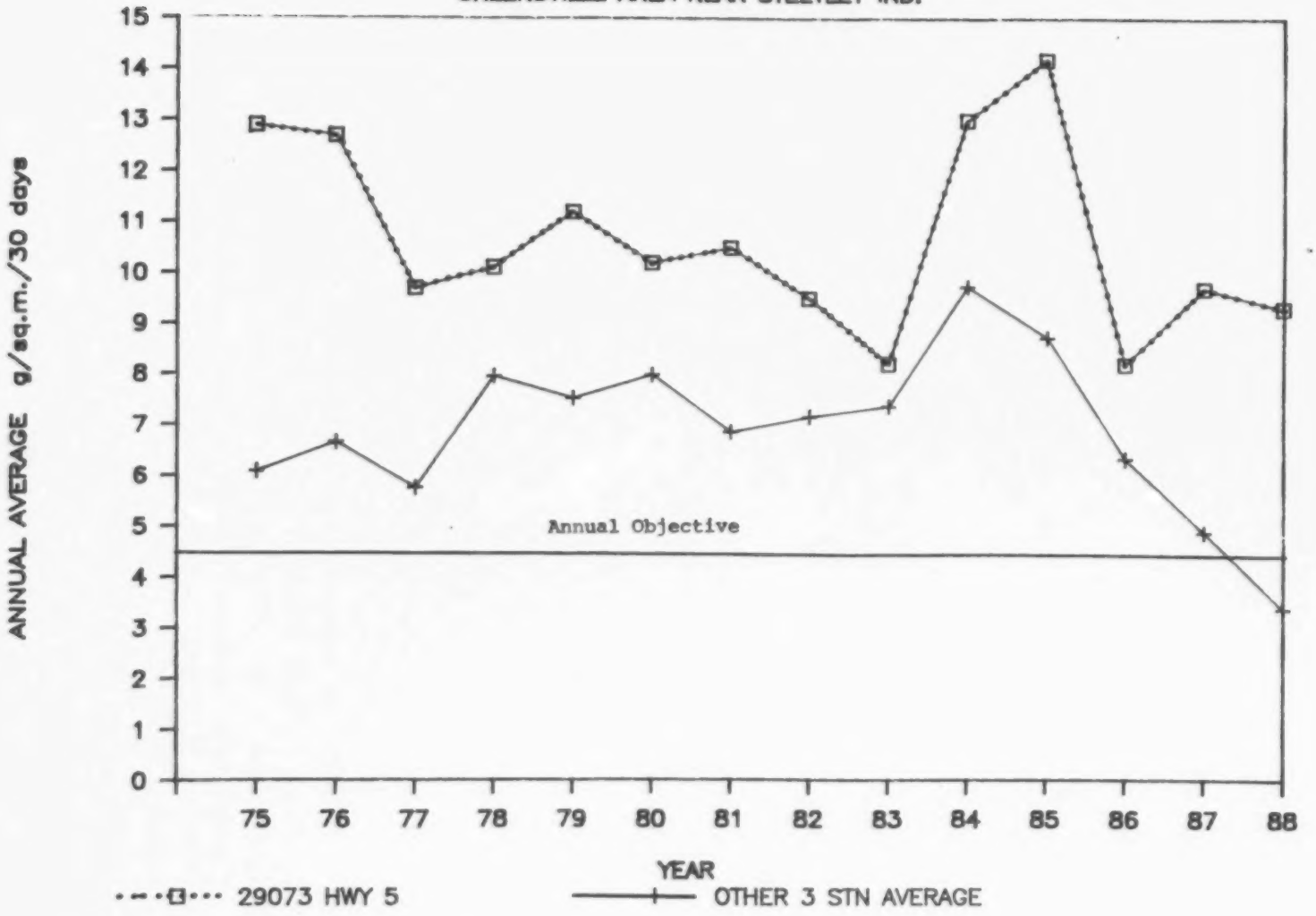


FIGURE 27
Map of Sampling Station Locations
Near Steetley Industries
Flamborough
N
82
83
84
29097
29098
29073
29273
29111
29074
29078
29076
STEETLEY
INDUSTRIES
Brock
Gardens
West
Flamborough

FIGURE 28

DUSTFALL YEARLY TREND

GREENSVILLE AREA NEAR STEETLEY IND.



6. DISCUSSION

There are two main air pollution problems in Hamilton, apart from occasional odours and dust fallout in the industrial area. One problem is short-term pollution build-ups during the spring and fall due to the presence of temperature inversions. The sources of this pollution are both vehicle traffic and industry.

The other problem is high ozone levels in summer, due to long range transport of pollutants. Ozone levels were much higher in 1988 than in previous years, due to increased temperatures.

During 1988, suspended particulate levels remained unchanged at most monitoring stations. The Air Pollution Index (API) reached the advisory level of 32 on one occasion during inversion conditions. The city's unique topography makes it very susceptible to inversions during which times pollution build-ups are unavoidable, and therefore, such incidents will recur in the future.

Dustfall levels throughout the city significantly decreased at most locations in 1987 and again in 1988 following little change in levels since 1970. No single initiative can be ascribed to this improvement. However, efforts by industry to control point sources and fugitive sources by such techniques as the use of chemical sealants, road paving, road washing and landscaping, together with improved street cleaning practices by the City may help to explain the trend. Further efforts must be made wherever possible. These can be both industrial and non-industrial in nature, such as controlling blowoff from unpaved areas, excavation,

construction, demolition, road traffic and stock piles and related materials handling. Further controls on industrial point sources will also continue where necessary.

The Hamilton air monitoring network has been expanded in recent years because of the introduction of the new Air Quality Index (AQI) in June, 1988.

A new telemetry system allows for immediate access to data, both in Toronto and in the Hamilton office and permits remote control and maintenance of instruments, all resulting in a more efficient monitoring program.

The new AQI is a function of six different pollutants, which form up to eight separate subindices. The highest hourly subindex becomes the AQI. Concentrations of sulphur dioxide, soiling index, carbon monoxide, nitrogen dioxide, total reduced sulphur and ozone are all individually converted to the old scale of index numbers (although not all AQI stations measure all six pollutants and all eight subindices). The advisory or alert levels remain the same as previously 32, 50, 75 and 100. The old API has been retained as one subindex and will continue to be used for industrial action requests should the API reach or exceed 32.

In Hamilton, four separate AQIs are being reported for the east, west, mountain and the new downtown station at Elgin/Kelly. The need for more than one index station in Hamilton has been apparent for some time as air quality can vary widely throughout the city at any given time.

The intent of the new index is to better inform the community about day to day air quality.

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